

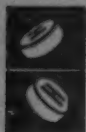
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VOLUME 28

FEBRUARY 1961

No. 2

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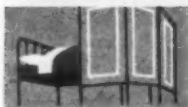
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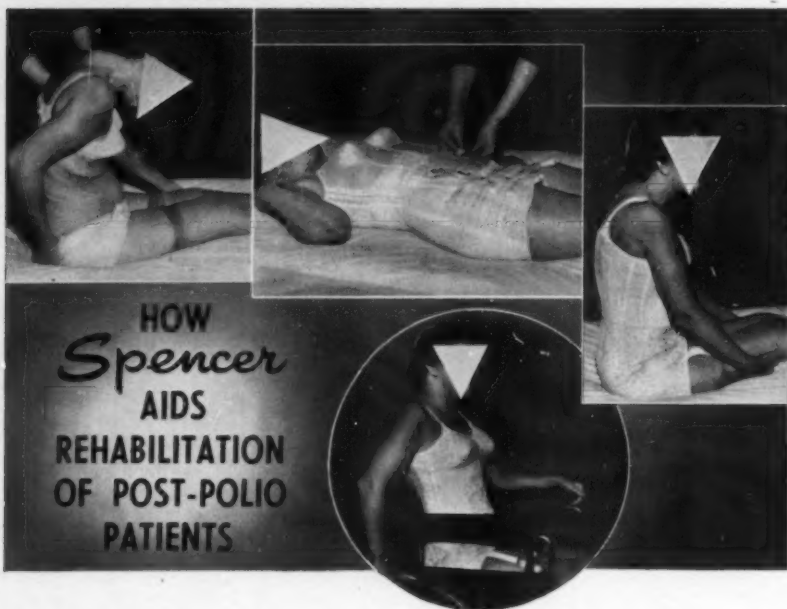
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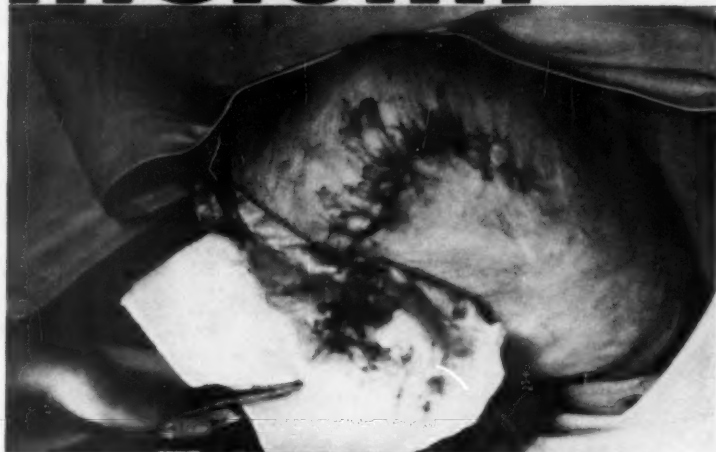


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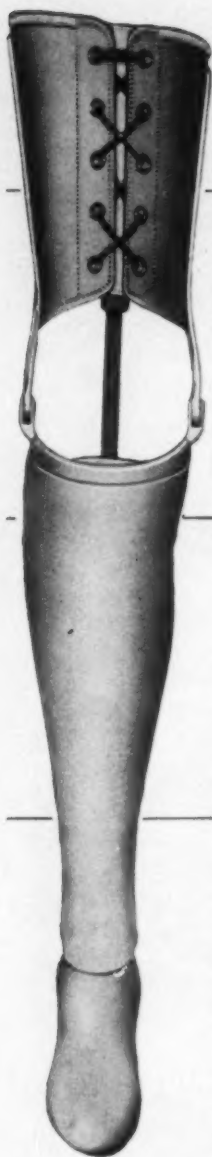
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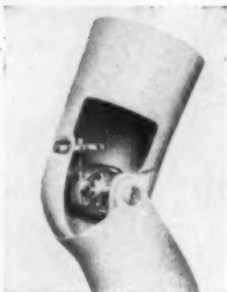
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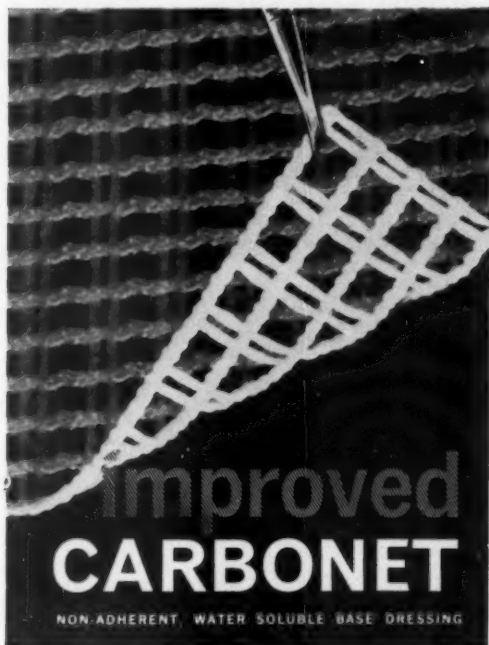
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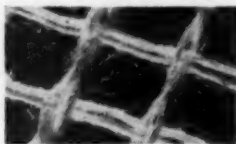


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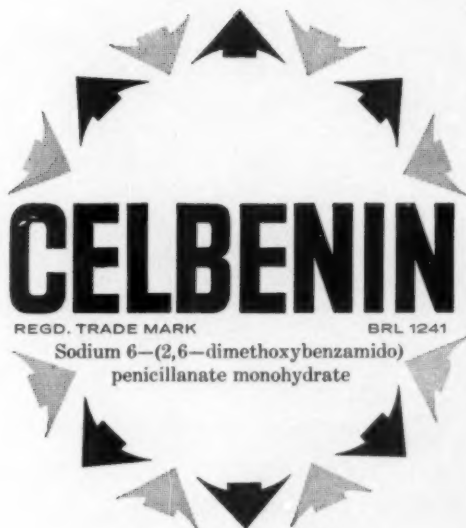
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EDITORIAL (1960) LANCET, II, 585

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*Annot., Lancet, i, 373, 1960.*

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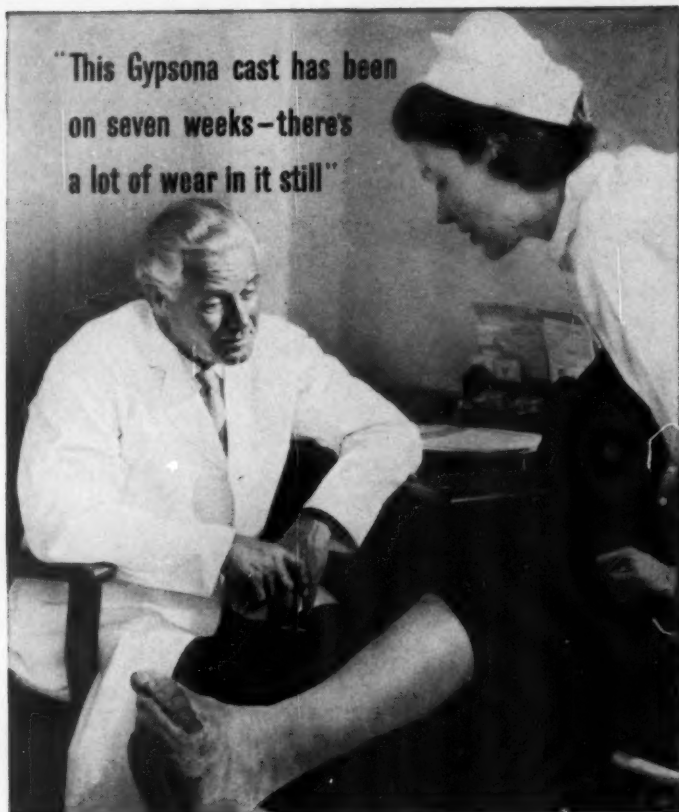
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## NEW TRENDS IN THE TREATMENT OF THROMBOANGIEIOSIS (BUERGER'S DISEASE)

Moynihan Lecture delivered at the Royal College of Surgeons of England

on

9th March 1960

by

**F. Orban, O.B.E.**

Professor of Surgery, Université de Liège, Belgium

INTO THE LIFE of every man there come crucial moments, and this, for me, is one of them. And it reminds me of another crucial moment which, at the time, was important too, but for a different reason. It was in October 1942, the day I was interviewed by the Royal Army Medical Corps board. I was asked: "What were you doing before the War?", and I answered, with an unmistakable accent: "Sergeant!" The reply was: "I see, you have already been in the Army!" I hope my pronunciation will not play the same trick on me this afternoon.

But today I am faced with another problem. Like all surgeons throughout the world, I have been taught to respect your venerable College, and if I accepted your invitation to lecture here, an honour as redoubtable as it is great, it is because I felt there were convincing reasons for doing so. First, the memory of Lord Moynihan, who foresaw and recommended international exchanges between surgeons; secondly, the confidence I have in old friends who are present; thirdly, my remembrance of my Master, Professor Leriche, who spoke to you just over 20 years ago on vascular diseases; and last, but not least, my devotion to your country. The years I spent with the Royal Army Medical Corps were decisive ones in my life, and if this meeting enables me to offer public thanks to the Medical Service that accepted me, it will not have been entirely in vain.

In this country, where so many physiologists and surgeons have contributed greatly to the understanding of vascular diseases, it might seem presumptuous to approach such a subject before the College. It is not my intention to force you to listen to an academic lecture on that branch of surgery: I only wish to draw your attention to a few clinical facts, and to give you an account of my reflections on Buerger's disease, which we prefer to call thromboangiosis rather than thromboangiitis, the latter denomination implying an idea of inflammation, and that is not proven. Finally, we shall discuss our therapeutic attempts.

It is worth recalling that the first anatomical description was written in 1878, in Vienna, by Winiwarter, an assistant of Billroth. Subsequently, the Chair of Surgery at the University of Liège was held by Winiwarter

from 1890 to 1917. Our interest in this line has not decreased in the last ten years; 580 lumbar sympathectomies, 57 upper thoracic sympathectomies, 30 suprarenalectomies and more than 1,800 arteriographs have been performed in our Department.

Thirty years after Winiwarter, Leo Buerger (1908) published his first paper on the disease, which has since borne his name. These monographs were the cause of many erroneous interpretations, which prevail even at the present time. Contemporary surgery is still suffering from the traditional anatomy which lay so heavily upon it, up to 25 or 30 years ago; indeed it has taken a long time for surgery to become a more physiological discipline. Not only the first description of thromboangeiosis but most

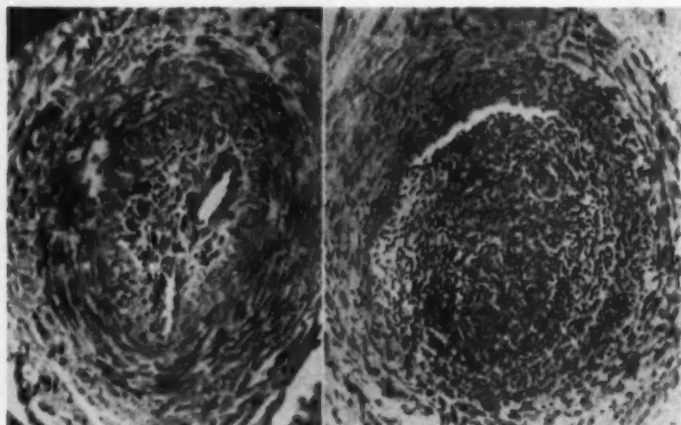


Fig. 1. Partial and ineffective recanalization through fibro-plastic block.

others also are based on studies of amputated limbs, the seat of year-long peripheral ulceration, and there lies the snag. The fact is that the criteria originally laid down to establish the diagnosis are wrong, because they were based on superimposed chronic infection.

In specimens taken in early cases and arteriectomies done at a distance from the extremity, we do not find the so-called "giant cells" and typical signs of inflammation which appear much later, after sepsis has been present for a long time. Professor Henry Dible has made similar observations.

The prominent feature is the presence of a thrombus in apparently healthy arteries. The clot is white in its peripheral segment, and red proximally; it has therefore crept up cephalad. It is only from the time the thrombus undergoes fibrinoplastic metaplasia that one can detect



the first reaction of the intima with stratified layers of thickening. After this, it becomes more difficult to distinguish what belongs to the clot or to the arterial wall. The media remain undisturbed, lipido-calcaneous deposits never appear. Some changes occur in the veins; much later does the pseudo-inflammatory process envelop the adventitia.

Recanalization takes place only in recent and short obliterations, otherwise repermeation does not intervene through a well-organized fibroplastic block (Fig. 1). Furthermore, at that stage it is histologically impossible to differentiate the picture of a Buerger thrombosis from a post-traumatic or post-embolic one. But the most striking fact is that the thrombus occurs in vessels which appear to be almost normal. In between the occluded segments, arteries may be perfectly healthy; lesions are

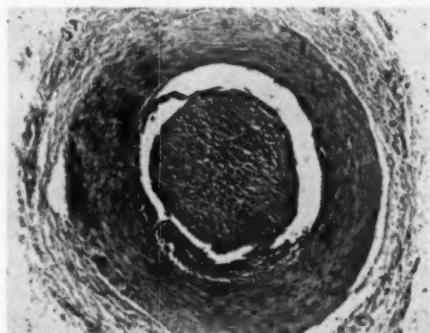


Fig. 2. Early case of thromboangioidosis (case R . . . ). Obliteration of digital artery (four weeks old) and cellular organization of the thrombus.

patchy, sometimes scattered all over several extremities, with "skipped areas", reminding one somehow of Crohn's disease. Moreover, in many places, one can see a shrinkage of small arteries below the obstacles (sometimes above it). This aspect of narrowing is well illustrated by arteriography; to us, it is the manifestation of spasm and of thrombosis.

### Histology

As we have already pointed out, the study of sections of vessels from amputated limbs can be misleading, and research should bear on very early cases, and actually I cannot remember having seen one in surgical literature. However, I think we can show you one.

A man, 37 years old, very strongly built and in perfect health, was awakened one night by intense pain in the tip of his left third finger; within a few days, the pulp became cyanotic and a tiny patch of gangrene developed. He was given, unsuccessfully, vasodilators by his general practitioner, and Novocaine block round the finger. He

F. ORBAN

kept on working as a garage mechanic. He died accidentally three weeks after the onset and, through the kindness of the Professor of Forensic Medicine, Paul Moureau, I was able to have the results of a very thorough post-mortem examination.

The digital artery of the finger involved showed cell proliferation coming from the intima, which was raised in places by new cells (Figs. 2 and 3), which have invaded the original thrombus (Fig. 4). There was no pathological change in the media. The disease seemed to start from the intima and progress towards the lumen of the vessel. A similar histological picture was found in vessels of the limbs, brain, bronchi and mesentery (the elastica was intact). In contradiction to this, in the aorta we found early signs of atheromatosis, quite different, with cellular changes and lipid deposits in the media.

What an extraordinary disease, when we think of that sturdy individual, apparently quite fit, while his visceral and limb arteries were marked by a generalized disorder progressing silently everywhere.

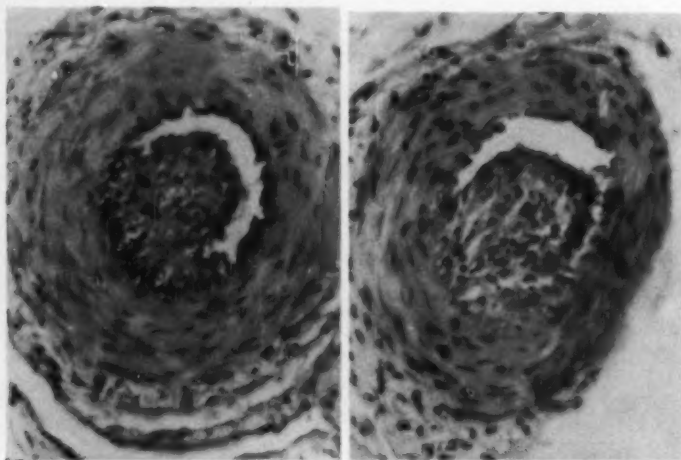


Fig. 3 (a) (Case R . . .) Cell proliferation coming from the intima. (b) (Case R . . .) Invasion of the lumen of the artery. The intima is raised by new cells.

In order to demonstrate how an artery can react under acute conditions, here is a rather disconcerting case.

A woman, 48 years old, who had always enjoyed good health, and had never suffered from any allergic disturbances or heart trouble, suddenly, while typing in her office, felt intense pain in all the fingers of her left hand. She was brought to us 65 hours later; she had no pyrexia, her blood was normal and no abnormality was detected in her heart: the classical picture of an embolus of the brachial artery. The fingers were white and cold (20° C.). There was complete palsy of the hand. Oscillometric readings diminished over the arm, and were absent in the forearm.

At operation, the brachial artery was pulsating, and no embolus could be felt. The radial artery was exposed 10 cm. above the wrist; there was no pulsation. Arteriotomy over a length of 10 cm. was performed; there was a recent embolus obstructing the vessel, with blood just oozing from proximal and distal arterial ends. We finished with

#### NEW TRENDS IN THE TREATMENT OF THROMBOANGIOSIS

a Smithwick operation (upper thoracic sympathectomy). The immediate result looked excellent: the pain had gone, the temperature of the fingers had risen to 31° C. Yet within three weeks, all fingers were affected by dry gangrene up to the first phalange. Amputation above the elbow was performed; there was a generalized thrombosis of veins and arteries. Healing *per primum* took place. Today, ten years later, she is very well, still working, but has had several benign attacks of phlebitis migrans, well localized, gradually disappearing after a few days. From the time of her menopause three years ago, she has had no more vascular trouble.

The pathological report (Professor Betz) (Figs. 5 and 6) stated: "Radial artery: fresh thrombosis; all layers involved by an inflammatory process. Granulomas erupting from the intima, very similar to the case discussed above. Culture: sterile."

We are at a loss how to classify this patient. It might be what is called "acute vegetative arteritis", although the patient never had any signs of infection, or a fulminating example of thromboangiosis. Yet histological pictures can be usefully compared. It seems the disease starts

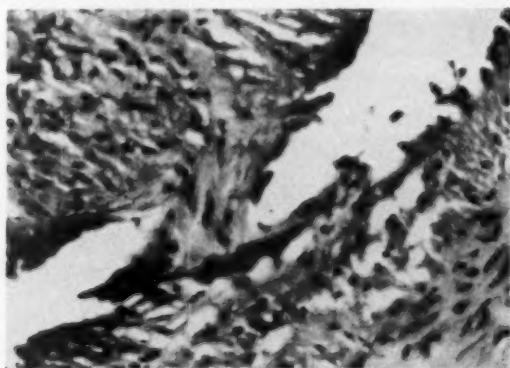


Fig. 4. (Case R . . .) High magnification of Figure 2 showing the track of penetration of intimal cells into the thrombus.

inside the intima but I cannot be positive about this. As Professor Dible wrote: "Something occurs which sets up thrombosis in vessels . . . which comes first, the vascular changes, or the thrombosis?" Telford and Stopford suggest that the primary lesion may be spastic occlusion of the vasa vasorum with consequent intimal alteration. I would be rather inclined to adopt that view, referring again to the first case shown, that of the man with a minute arterial thrombosis of one finger, and giving evidence of changes in the intima all over his body!

#### Localization

Usually, the disease originally affects the distal vessels of fingers and toes, radial and tibial arteries, although the popliteal artery is very often involved (Wertheimer and Sautot (1958)—50 per cent.). Upper limbs are

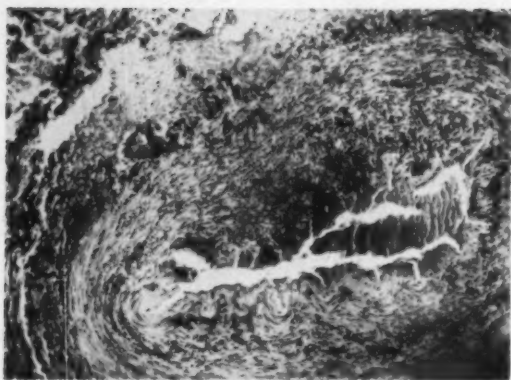


Fig. 5. (Case De P . . . woman, 48 years old—acute thrombosis of arteries and veins of upper extremity.) Radial artery, peri- and intramuscular inflammatory reaction, all layers are involved.

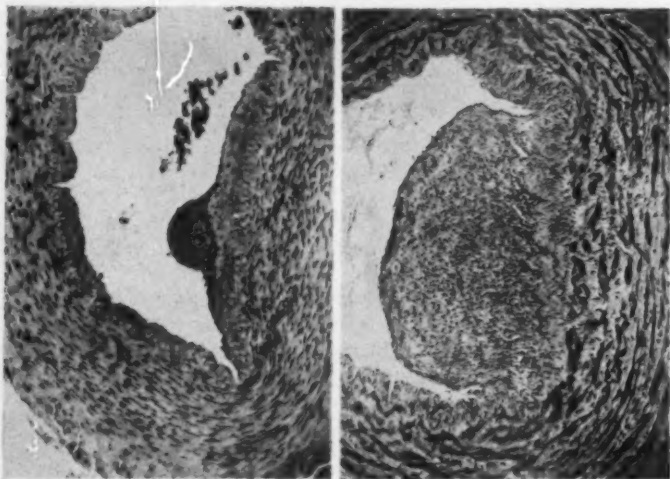


Fig. 6 (a) (Case De P . . .) Ulnar artery, granuloma erupting from the thickened intima (compare to Fig. 3 (a) and (b)). (b) (Case De P . . .) Venous thrombosis, same process as in arteries.

#### NEW TRENDS IN THE TREATMENT OF THROMBOANGIEOSIS

nearly always involved sooner or later; and we have seen obliteration of the radial and ulnar arteries years before the patients complained of their hands. Besides, more than 40-50 per cent. of the patients develop visceral and central thrombosis (brain, heart). As a rule, pelvic arteries remain undamaged.

#### Arteriography

Aortography: we have been using the fluorescein test: histamine wheals are raised on the popliteal fossa and on both tibial malleoli. 30 c.c. of sodium fluoresceinate solution are injected into the aorta; the normal average blood speed is 5-6 seconds for the knee, 10-12 seconds for the foot. It is the only way to reckon an adequate timing and to get a full injection of the foot; in some patients, one has to wait 23-30 seconds before taking the leg and foot X-ray.



Fig. 7. (a) Buerger's disease. Gangrenous patches on tips of index and middle finger, whose digital arteries are distally obstructed. (b) Buerger's disease. Arteries are thin, fine-drawn, obliteration in Hunter's canal poor collaterally.

Arteriographic pictures are well-known: general shrinkage of peripheral vessels, thinning of the most distal part, patchy, erratic distribution of the obliterations more localized at the extremities to start with (Fig. 7 (a) and (b)). Collateral circulation varies according to the duration of the disease, tributaries look fine-drawn; in any case, collaterality is always less developed and less extensive than in atherosclerotic arteritis. Only arteriography can elicit cascade-like obliterations and the precise condition of small peripheral vessels.

### Aetiology

Various aetiologies classically discussed—infection, tobacco, ergot, race—do not represent more than a historical interest.

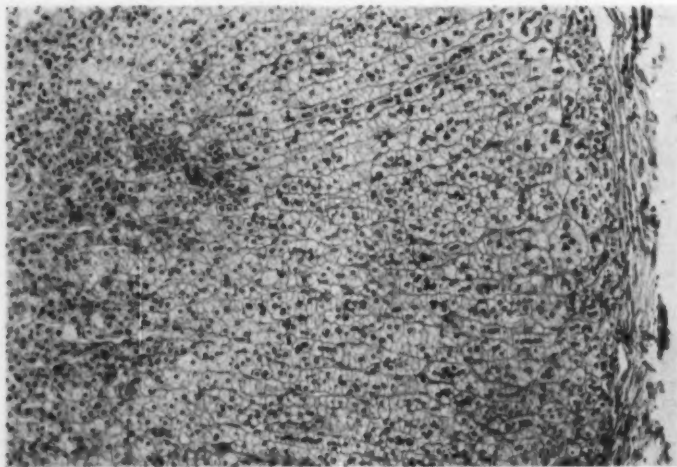


Fig. 8. Thromboangiitis of suprarenal: enlargement of fasciculae, glomerulosa extremely reduced.

Apart from arteries and veins, pathologists have described other lesions in thromboangiitis; we may say we are not convinced by some papers describing degenerative changes in sympathetic ganglions.

But the study of the adrenals throws more light on the subject. Leriche (1946, 1949, 1954) and Fontaine (1950) had already emphasized that 75 per cent. of adrenals examined showed important changes in the cortex. Many other surgeons have made similar observations (Wertheimer (in 60 cases), 1958; Pettinari *et al.*, 1953, 1959 (61); Tingaud, 1952; and Carls (20), Ferrand and Elbaz, 1958, etc.).



I can produce the pathological reports of my 13 personal cases; they are exactly comparable to the French and Italian findings. Here is Professor Betz's report: "The study of the adrenals in 13 cases of Buerger's disease

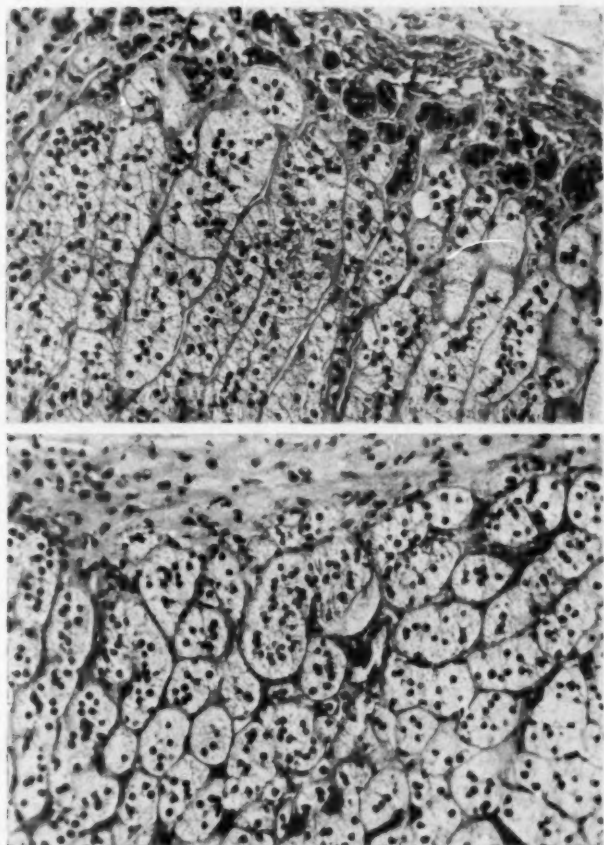


Fig. 9. (a) Left suprarenal (Case Ba . . .). Spongiocytes full of lipoids; just a layer of glomerulosa cells is still present. (b) (Case Ba . . . same as Figure 9 (a)). Right suprarenal nine months after left adrenalectomy. Glomerulosa has disappeared and there are no signs of compensatory hypertrophy.

reveals in all of them the same modifications of the cortex: hyperplasia of the fasciculata and wearing down of glomerulosa (Fig. 8). The fasciculata is noticeably enlarged and made of spongiocyte cells full of lipoids; in many cases pseudo-adenomatous formations can be found. The outer

part, the glomerulosa, is hardly discernible as such, the fasciculata contacting the capsule at various points. The reticularis (inner) does not show perceptible changes (Figs. 9 (a) and (b))."

No signs of compensatory hypertrophy were seen on the occasion of the second adrenalectomy (three to seven months elapsed between the two operations).

There is a general consensus of opinion that in thromboangeiosis the suprarenals show signs of dysfunction, even of overactivity (150 patients reported up to now).\*

### Physiopathology

I should like to state that I have the greatest respect for experimental surgery, but it must be said that in vascular pathology experiments on animals have sometimes led to certain blind alleys. The sympathetic system of the rabbit, or of the cat, is not the same as that of the dog, and in any case it could hardly be compared to that of a sick man. Moreover, it must be remembered first of all that these animals never develop spontaneous gangrene. Man is "an animal without fur or feathers" (Leriche), and has a vascular system which reacts in its own way, and quite differently in health and in disease. And yet human beings can be very different one from another; one reads in any text book: "cold, fear, mental excitation, etc., will result in vasoconstriction of the face and extremities and will be expressed in pallor". This is partially true, but we know that many people will blush and get red all over under the same stress. Have we not met some good-looking girls whispering a lie, one becoming apparently bloodless, the other becoming bright red? Some young recruits on the battlefield are rooted to the very spot by diarrhoea, while their companions may be constipated.

These commonplace facts are not very academic, yet it is high time that they should be accounted for in the interpretation of man's diseases.

The whole problem of thromboangeiosis is dominated by two features: spasm and thrombosis.

*Spasm* is an undisputed observation. Very early in the disease, before the appearance of any obvious pathological signs, most patients show excessive reaction to cold, in fact a sort of Raynaud phenomenon; later, spasm attacks may be so severe that they simulate arterial embolism. Besides, aortography visualizes those areas of vasoconstriction below the obstruction (sometimes above). All the same, the returning pulse, the increase of local temperature following sympathectomy, arteriectomy (and

\* Some authors have published comparable findings in adrenals of atherosclerotic arteritis patients; they assume this would be the clue to the fact that both diseases may have a common link in the adrenal disturbances; it is still an open question.

also adrenalectomy) plainly demonstrate the existence of spasm. The part played by the central and sympathetic nervous system and by hormones are classical knowledge, though very confused, but when it comes to analysing the local mechanism of spasm at artery level, arguments wax fierce. In this country, generally speaking, very few people believe in intra-mural centres in the artery; they would rather claim that the smooth muscle of the arterial wall just contracts according to the pressure gradient of the blood flow. I do not entirely share this view, and am more inclined to think there must be "some peripheral conducting mechanism".

Let us go into more details on this point. We know that in man a cervical rib, a callus of the clavicle, the pressure of crutches or an iliac abscess can bring about downward vascular spasm. It has been shown by arteriography and relieved by surgery.

I remember a soldier, 28 years old, who had had a bullet through the thigh. I saw him seven months later complaining of coldness of the foot and intermittent claudication; he showed signs of severance of the internal saphenous nerve. Under local anaesthesia, we exposed the femoral artery; it was beating normally above an adhesion with a neuroma of the saphenous nerve; below, the artery was rigid, contracted. There were no traces of a proper arterial injury. Immediately after the neuroma coalescing with the adventitia was separated, the artery below started to beat normally. The patient was relieved of his femoral spasm, and twenty years later he is still leading a very active life; in fact, he still plays football. This is evidence that an artery with a healthy wall can go into spasm through local stimulation.

It is still more true if the artery wall is diseased. Thirty years ago, with the then so-called "dogs without arteries", we demonstrated the spasmogenic influence of a ligature round an artery and the vasodilating effect of arteriectomy (with or without sympathectomy) on collateral circulation. Now, of course, arteriectomy has given way to grafting, although there are still some occasions when it is indicated. For instance, in Leriche's syndrome (bifurcation obliteration), when grafting appears unfeasible, excision of the bifurcation combined with bilateral lumbar sympathectomy can give good results.

A man, 28 years old, was treated during the Spanish war by ligature of the femoral artery in Hunter's canal. Six years later, intermittent claudication (X-ray: complete block at the lower third) was moderately relieved by a lumbar sympathectomy. Three years later he had pain and claudication, which became worse. The foot was cold, and oscillometric readings were almost absent. At the time, we did an arteriectomy of the obliterated segment (old ligature site) and within a few hours the foot became warm, and oscillometric readings reappeared. The patient made a full recovery after an arteriectomy done nine years after a ligature, and two years after an unsuccessful lumbar sympathectomy.

Experimentally, it has been shown that chemical obliteration of arteries can bring about distal changes in the intima, eventually going into thrombosis in the vessel below. In their memorable experiments Reilly and Laplan have beautifully illustrated the same conception. By injecting strictly underneath the intima some diphtheria endotoxin, they were able to create all histological phases of vascular disease: spasm, intimal proliferation, thrombosis, very similar to thromboangiitis; the previous

painting of the artery with phenol would prevent the whole process. Quite recently, S. M. Hilton published a very good paper in the *Journal of Physiology* (1959) on similar effects of direct application of various drugs on the conduction along arteries.

In true Raynaud's disease of long duration, one can see digital blocks on arterioles which have suffered from repeated attacks of spasm. The whole process develops as if repeated spasm could lead to thrombosis which is the ultimate end of the disease. If this was not the appropriate explanation, how could we make out these cascade-like thromboses, interspersed with normal segments, and when blood is quite normal?

Does vasoconstriction of vasa vasorum alter the intima and then allow platelets to conglomerate to it, thus causing coagulation? It is very plausible, and, in my opinion, it is the best working hypothesis. And when we talk of circulation, we do not confine ourselves to the artery alone, but we also think of the satellite vein and nerve. It is just another case of the eternal triangle!

#### Treatment

We do not have great faith either in intravenous injections of saline or of typhoid vaccine, or in a diet deprived of rye bread. As regards anti-coagulant treatment, strongly recommended by distinguished doctors, we can only say that we have no experience of it. Nevertheless, results are conflicting, and to me it seems very difficult to keep patients for years at an appropriate level of hypocoagulation. Furthermore, if we are to believe that the trigger lesions lie in the intima, one wonders how such a specific blood medication could work.

#### Sympathectomy

The primary aim of the treatment has been to prevent gangrene, or at least to retard its appearance for some time. It was known that sympathetic tone being at its highest at the extremities, sympathectomy would have the maximum effect over these distal parts, and consequently sympathectomies were done many years ago. Increase of blood flow and of local temperature were recorded after these operations, but it became obvious that after a few weeks they tended to diminish, peripheral blood flow and temperature having a progressive tendency to fall to various levels. There is no doubt that it is the English school which has carried out the most thorough investigations on the physiology of the sympathetic system, and it is beyond the scope of this lecture to discuss it.

I wish only to make a few clinical comments. It is generally contended that post-sympathectomy vasodilatation is limited to the skin of the foot and of the hand and is, as I have said, of rather short duration. I agree partially with that view, and I think there is some answer in the arterial

tree and in the muscles of the limb concerned. Ruberti and co-workers (1960) and Scarabelli and co-workers (1959) have published very accurate recordings supporting that view (even years after operation).

With regard to duration of results of sympathectomy, there is something more to say. We do know, of course, that many sympathectomized patients have recurrences of vasoconstriction attacks, of sweating, and so on, but, oddly enough, not all. You certainly know as much as I do of patients operated on, years ago, who still have warm, non-sweating extremities (10, 15, 30 years). To me, these so-called "exceptions" have a great importance; they signify that under unknown individual (hormonal?) conditions the effects of sympathectomy may last for a very long time. The more physicists provide us with sensitive electronic gadgets, the more we find recordings of fairly valuable blood-flow years after sympathectomy. There are many anomalies in the observation of sympathectomized cases. For instance, you have certainly observed patients exhibiting signs of returning sympathetic activity and still doing well; we also know that failure of the pulse to return does not preclude a good clinical result. As an hypothesis, one could assume that in some cases, after sympathectomy, the arterio-venous shunts (glomus, Sucquet's canals) remain permanently dilated, allowing a relatively adequate blood supply, with hands cold and blue.

Whatever the scholastic arguments may be on regeneration, sprouting, reorganization of the interrupted sympathetic, what are the results of sympathectomy in thromboangioma? About 60 per cent. of patients draw benefit from the operation: ulcerations heal, pain is lessened; in rare cases, intermittent claudication is improved, but after a variable length of time, patients will come back with recurrences and aggravation of all their symptoms. That was bound to happen; with sympathectomy, we have attacked only one aspect of the disease, spasm, but nothing has been done against thrombosis.

When there is no return flow of the blood in the main arterial tree below an established thrombosis, no surgery can save the limb. That very much disregarded notion is the reason of many failures of surgery in thromboangioma.

It would be ideal to restore the circulation with grafts, but that wonderful technique is not applicable to our problem. Thromboangioma is a disease in which the successive outbreaks occlude the artery at multiple levels with prevalence in the extremities, so that local surgical approach is impossible.

For many years, however, surgeons have been trying to find another way to fight the disease at its roots. A new field was opened by Oppel, when in 1921 he performed the first adrenalectomy, assuming (wrongly) that



adrenaline was the cause of thromboangioidosis. In 1925, Leriche and his school followed suit, as did the Italians; in 1947, Leriche wrote a paper on 98 adrenalectomies combined with lumbar sympathectomy and contralateral-splanchnicectomy.

At the European Congress of Vascular Surgery (1952), Fontaine and Dos Santos stated that adrenalectomy (combined with sympathectomy) was an operation of value, which apparently seemed to slow down or even check the pace of the disease.

Out of 66 patients thus treated, they registered 74 per cent. of good results (compared to 53 per cent. for patients treated by sympathectomy alone); Wertheimer (57 cases) and Pettinari and his colleagues (61 cases) had produced similar results. Even if that period of surgery was purely empirical, it nevertheless raised interest, and undoubtedly patients did improve. With that technique, effects of sympathectomy appear reinforced and prolonged; recurrences are less frequent and take place later. At that time we had already stressed a most intriguing fact: some patients *not* improved by sympathectomy were much relieved by a later unilateral adrenalectomy. You may object—"that is grossly unscientific"—and I would agree with you; yet they just happen to be human facts.

In the meantime, research on the physiopathology of the suprarenals was being carried out in many places, and resulted in new facts.

Very early on, we realized that repeated adrenaline injections could not induce changes in vessels. Later, a few others (Naggi and Parodi, Froelich, Cavalli, Lucinisco, Pico and Scartozzi) attempted the same thing with successive grafts of adrenal in the rabbit. But their results remain disputable; they produced variant images of thickening of the intima and scattered thrombosis.

Selye and co-workers, in 1943, published a series of thrilling experiments on many animals (chicken, rat, dog, monkey, guinea-pig). With a prolonged course of injections of desoxycorticosterone (DOCA), combined with either a salty or salt-free diet, they created in arteries many surprising changes; some are similar to periarteritis nodosa or arteritis obliterans and also to thromboangioidosis.

In many cases, the similitude is absolutely striking, including final images of granulomas and thrombosis. But perhaps the most interesting part of Selye's work is the following: the concomitant administration of glycocorticoid prevents any deleterious effects of DOCA on arteries; it stops the formation of experimental arteritis. Even if the interpretations of the microscopical sections can be argued, there is a logical conclusion to be drawn: the mineralocorticoids can cause deep vascular alterations. Physicians had already noted vascular disturbances, sometimes serious, in patients treated by ACTH or DOCA.

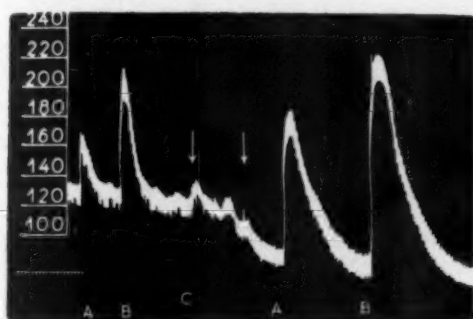


#### NEW TRENDS IN THE TREATMENT OF THROMBOANGIOSIS

That was roughly what we knew of the possible relation between adrenals and vascular disease until about 1945. Since then, biochemists have been hard at work and the matter of adrenal activity has become a large province of physiology (more than 30 cortico-steroids have been described so far).

The big impact was caused by the synthesis of cortico-steroids, thus making possible bilateral adrenalectomy.

This technique, at first applied to Cushing's disease, adreno-genital syndrome and metastasis, was later tried in vascular diseases. It appears that in some cases of malignant hypertension (Green *et al.*, 1947), and in



*Reproduced by courtesy of Prof. J. Lecomte.*

Fig. 10. (Cat.) Dial Ciba intraperitoneal anaesthesia. Bilateral cervical vagotomy. Tracheostomy and intubation. Time 5 seconds. Diagram of carotid pressure.

in A: Injection of levogyre Adrenaline (2.5 mg./Kg.).

in B: Injection of levogyre Adrenaline (5 mg./Kg.).

in C: in between the two arrows, injection of 10 mg./Kg. of hydrocortisone (alcoholic solution).

The hypertensive reactions due to adrenaline are increased in peak and duration by the injection of hydrocortisone. (The drop of the blood pressure observed after hydrocortisone injection is an effect of the ethylic alcohol, which by itself has no sensibilizing property.)

degenerative arteritis of diabetes (Kimmelstiel-Wilson syndrome) (Wortham and Headstream, seven cases), there is overactivity of the adrenal cortex: in both conditions, good results of adrenalectomy have been recorded. Naturally, the idea of bilateral adrenalectomy in thromboangioma seems even more imperative.

We have already discussed earlier the anatomical, clinical and experimental reasons for suspecting the adrenal of being one of the causes of the disease, but let us have a look at the latest advances biochemistry has made along that line.

Many dosages of steroids have been published in relation to man's diseases; not very many can be retained; either the methods used have proved to be deceptive, or samples have been limited to urine (we know this is quite inadequate), or the chemical work has simply not been done properly. I am no biochemist but, watching the work done in my hospital by a team of highly specialized colleagues, I realized the pitfalls of the techniques, and the skill required to reach valid conclusions. Therefore, I think we have to be extremely careful when evaluating steroid dosages in thromboangioidosis.

Some steroids, for instance, are quickly metabolized and, so far, their precise tracing is very difficult. In the past few years, several papers have been published, giving reliable figures tending to demonstrate an increase

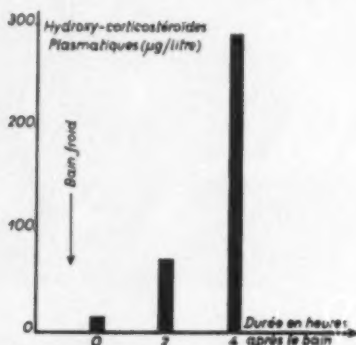


Fig. 11. Rate of 17-hydroxycorticosteroids in a patient suffering from cold hypersensitivity. The left limb was immersed in an icecold bath, at 0 time. Strong increase of the plasma content in 17-hydroxycorticosteroids following liberation of endogenous histamine induced by the cold bath. (Average rate of 17-hydroxycorticosteroids : 5 mg. per cent.)

of some steroids and catecholamines in thromboangioidosis. You will see in a moment my own figures which are reliable, I hope, though I insist it is still a very intricate problem.

Yet physiologists have confirmed, beyond doubt, functional interrelation between the cortex and the medulla: (a) adrenaline stimulates the secretion of corticosteroids, (b) hydrocortisone increases the peripheral effects of adrenaline (Van Cauwenberghe *et al.*, 1959). This somehow throws the limelight, although in an indirect way, on the action of adrenaline on vessels (Fig. 10).

I can show you a very different condition in which vasospastic attacks are also accompanied by a tremendous increase of the plasmatic 17-hydroxycorticosteroids; among stress-inducing agents, cold is classically

admitted as being one of the most potent stimulants of cortical activity. Here is the case of a woman, 35 years old, sent to me as a Raynaud's disease; as a matter of fact, it was a true case of hypersensitivity to cold: immersion of one forearm in ice-cold water brings about all signs of hyperhistaminaemia: redness of the face, tachycardia, hypotension, headache, etc.: gastric pH rises from 1 to 5, histaminaemia from 17 mg. per cent. to 25 mg. per cent., and plasmatic 17-hydroxycorticosteroids jump from 30 to 300 mg. (Fig. 11).

According to what we have seen from the last arguments discussed, it seemed logical to suppress at one stroke the source of mineralo-corticoids, the adrenaline, nor-adrenaline and their noxious vasoconstrictive effects in a disease of which the dominant feature is, most emphatically, spasm.

There must be an intermittent functional origin to explain the acute outbreaks and remissions of the disease, in spite of grossly established obliterations, and thus one is inclined to relate them to a hormonal cause.

There is another point. As we said, it is admitted that sympathectomy has an indication in thromboangeiosis. It is also believed that sympathectomy hypersensitizes vessels to adrenaline (and nor-adrenaline), thereby doing more harm than good. I will, therefore, find more reasons for cutting off the supply of these noxious hormones. We somehow had a hint of this whilst observing the surprising effect of unilateral adrenalectomy after failure of sympathectomy. For the first time, we could hope to treat more than the secondary signs, and to get closer to the essence of the disease.

Was it ethical to suggest bilateral adrenalectomy in thromboangioid patients?

To start with, I would like to remind you that the whole world followed Huggins after he published his findings on 18 cases of total adrenalectomy in 1952. By now, we know of about 61 cases of bilateral adrenalectomies, total or sub-total, in thromboangeiosis—enough apparently to take a decision.

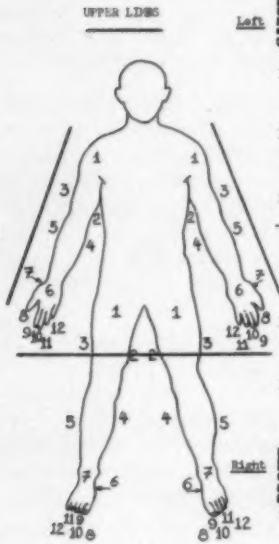
Before answering this question about total adrenalectomy, I would like to quote Telford (1937): "In a disease so variable in its rate of progress and its severity as thromboangeiosis, it is very difficult to judge the efficacy of any one treatment". This is correct, but concerns a certain number of patients in whom the disease is of slow evolution, quiescent; but on the other hand, we know of many patients in whom the course of the disease is fast, implacable, leading to death through successive outbreaks of gangrene.

Therefore, it is our duty to do our utmost to help these patients, namely, we should try everything that is sensible and innocuous, even if we do not

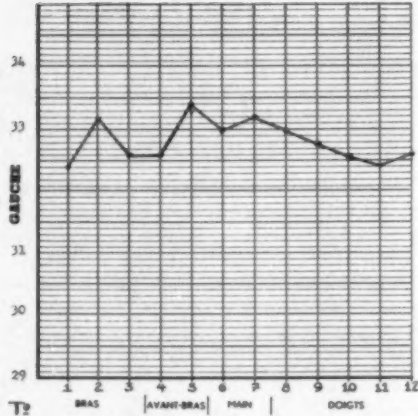
Mr. Paul  
22 Jan. 60

UNIVERSITÉ DE LIÈGE  
CLINIQUE CHIRURGICALE

TEMPÉRATURE CUTANÉE  
Skin Temperature (cigrades)



Upper Thor. Symp. 1 Aug. 56



Upper Thor. Symp. 13 Jul. 56

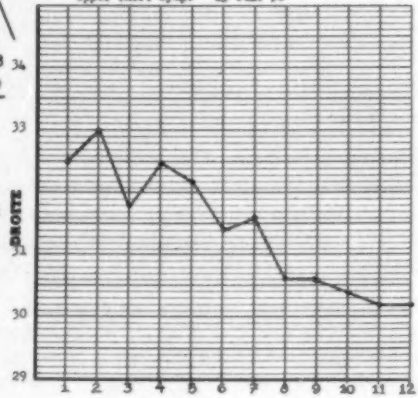


Fig. 12.

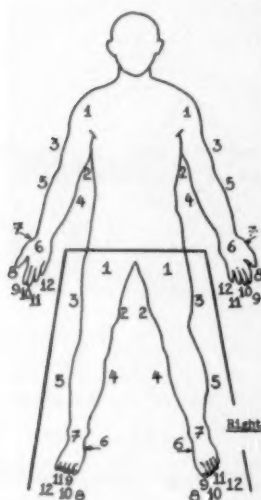
# NEW TRENDS IN THE TREATMENT OF THROMBOANGIOSIS

MAR. Paul  
22 Jan. 60

UNIVERSITÉ DE LIÈGE  
CLINIQUE CHIRURGICALE

TEMPÉRATURE CUTANÉE  
Skin Temperature. (c/grades)

LOWER LIMBS



LEFT ADRENALLECTOMY : 10 Oct. 56  
RIGHT ADRENALLECTOMY : 12 Jan. 57

Lumb. Symp. (1<sup>1</sup>2<sup>1</sup>3) 10 Oct. 56

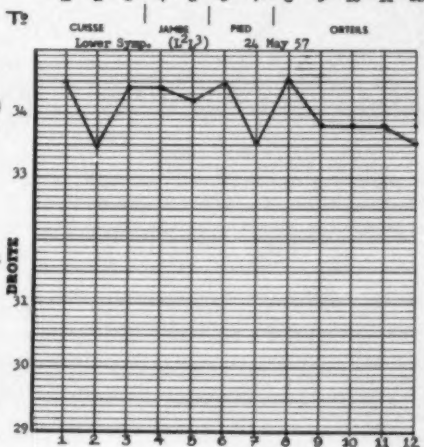
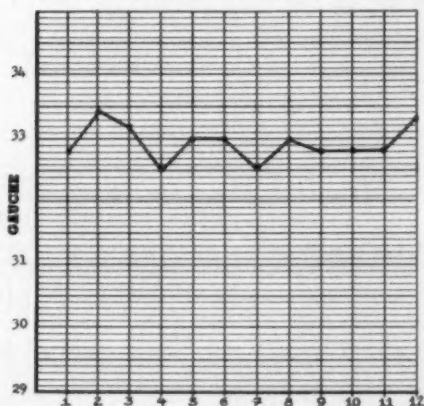


Fig. 13.

fully understand the whys and wherefores. Leriche wrote one day: "Any new operation which establishes a new order of things, arouses controversy which seeks the support of figures . . . that is the ransom of progress; even if these objections are stimulating, they are only verbal, non-constructive criticism."

In the last few years, our plan has been as follows: the first step, at the very first sign of the disease, is to try to convince the patient that he has to go through a series of operations, even if he thinks he is cured after two or three stages.

### Technique

The full programme is: bilateral subtotal adrenalectomy (leaving  $\frac{1}{2}$  gr. =  $7\frac{1}{2}$  gr.) of the right one, with extensive sympathectomy of four limbs.

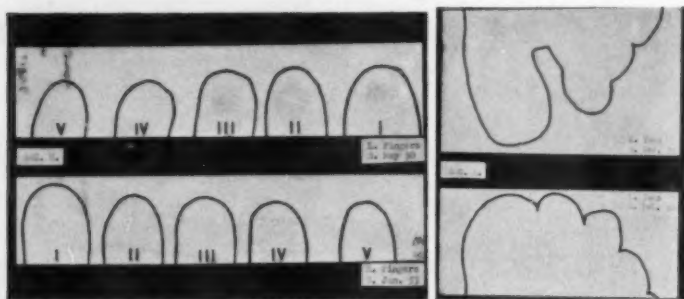


Fig. 14. (a) Ninhydrine test (Patient Sa . . . , No. 2, see Table I). Monolateral adrenalectomy. Absence of sudation in upper limbs seven years after upper thoracic sympathectomy. (b) (Patient Sa . . . , No. 2.) Absence of sudation in lower limbs 10 years after lumbar sympathectomy. Temperature of toes and fingers  $32^{\circ}\text{C}$ .

As a rule, when the patient is in pain, we start by doing a sympathectomy on the side involved, i.e. left lumbar sympathectomy  $L_1, L_2, L_3$ , combined with a left total adrenalectomy (retroperitoneal approach); then, according to the prevalent symptoms, right lumbar sympathectomy ( $L_2, L_3$ , left upper thoracic sympathectomy, posterior approach), right sub-total adrenalectomy plus right upper thoracic sympathectomy. We usually perform the last stage this way: the right thorax is opened between the 7th and 9th ribs, a right upper sympathectomy is done intrapleurally; then we open the diaphragm parallel to the rib to find the suprarenal beautifully exposed from above. This technique enables us to dissect the gland very gently, without any pressure or pull; this is how we make sure of the amount of gland (6-8 gr.) we wish to leave behind with an undamaged



# NEW TRENDS IN THE TREATMENT OF THROMBOANGIEIOSIS

blood supply. For the posterior approach for upper thoracic sympathectomy (extra-pleural), we use the sitting position. The patient being on a neuro-surgical table, the process is very easy, and he hardly bleeds at all.

We think it is advisable to group operations over a rather short period (eight to 10 months). When one waits too long between operations, results are less spectacular.

You will, not without reason, raise the objection: "If you are consistent with yourself, you should do a total adrenalectomy and not leave a source of harmful hormones behind!" I think I can answer that: (a) on ethical

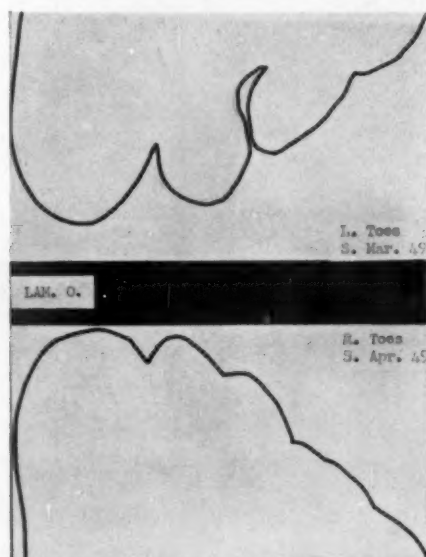


Fig. 15. Ninhydrine test (Patient Lam . . . No. 4). Bilateral subtotal adrenalectomy. No sudation 11 years after lumbar sympathectomy.

grounds, we do not dare impose on young individuals such a drastic operation. As Ferrand has said, "most of them have to remain 'out-patients' of the hospital for ever".

(b) If the remnant of the gland left behind is just enough to take care of ordinary daily needs, it cannot be considered as an appreciable source of noxious secretions. As a matter of fact, all our patients are on the verge of Addisonism, as proved in our charts. In case of minor stress (overwork or a mild attack of influenza), they have to compensate with 5 or 10 mg. of hydrocortisone.

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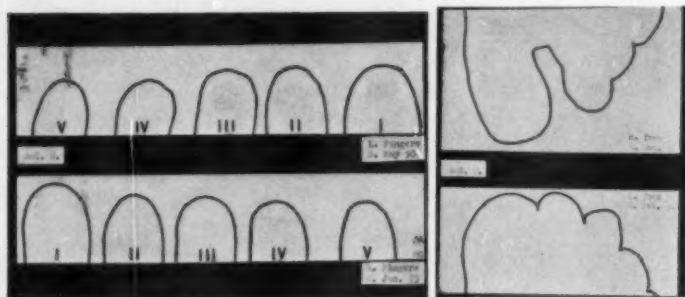


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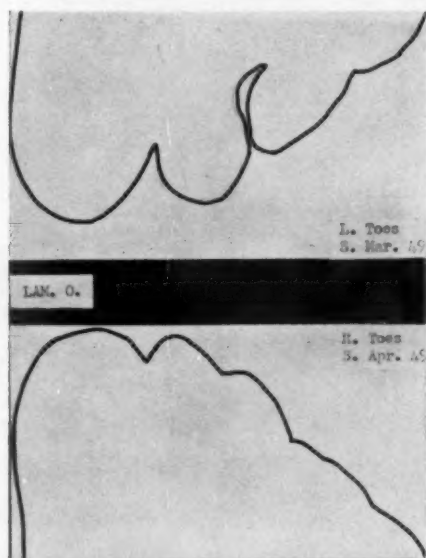


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## F. ORBAN

TABLE I

Names	Age	Sympathectomies								Adrenalectomies				Cortisone Daily Intake
		Upper				Lumbar				L		R		
		L		R		L		R		L		R		
1. Deb.	32					XI	49	X	49	XI	49			
2. Sac.	40	V	50	I	53	II	50	XII	50	II	50			
3. Pid.	43					III	56			III	56			
4. Lam.	46	V	59	VIII	59	III	49	IV	49	V	59	VIII	59	
5. Rot.	31					I	55	III	55	I	55	III	55	
6. Pro.	37					IV	56	IX	55	IV	56	X	57	
7. Mar.	29	VIII	56	VII	56	X	56	V	57	X	56	I	57	
8. Thi.	36	I	60	V	59	I	57	XII	56	I	57	V	59	
9. Hol.	34	X	58	I	60	XII	56	III	58	XII	56	II	57	
10. Bat.	44	XI	57	I	58	VII	58			VII	58	X	58	
11. Moe.	34					I	58	XII	57	I	58	III	58	
12. Ste.	42				XII	59	IV	58	X	59	VIII	58	XII	59
13. Lem.	26	III	59	IV	59		49		49	III	59	IV	59	

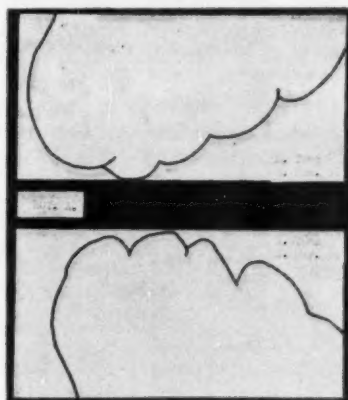
TABLE II

GANGRENS AND ULCERATIONS  
(on admission)

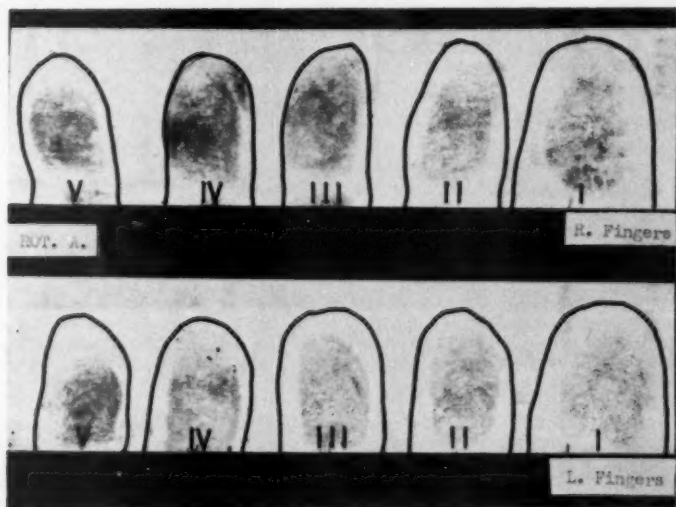
		Sympathectomies		Present result
		Upper Limb	Lower Limb	
1. Deb.			ulceration first R. toe	healed (still smoking)
2. Sac.			ulceration third L. toe	healed
3. Pid.			gangrene second L. toe	amputation (second toe)
4. Lam.			gangrene first L. toe	amputation (first toe) (still smoking)
5. Rot.			gangrene third L. toe	amputation (third toe)
7. Mar.	gangrene second R. finger ulceration third L. finger		gangrenous patches on several L. toes gangrenous patch first R. toe gangrenous patches on several toes of both feet	healed healed
9. Hol.			gangrenous patches on first L. toe, fifth L. toe	healed (still smoking)
10. Bat.	gangrene on tips of second/third L. fingers; fourth/fifth R. fingers			healed with pulpar atrophy
11. Moe.			ulceration first R. L. toe	healed
13. Lem.			gangrene first L. toe, fifth R. toe	amputation left foot healed temporarily amputation right leg

N.B. Seven patients suffered from acrospasms of the upper limbs.

NEW TRENDS IN THE TREATMENT OF THROMBOANGEIOSIS



(a)



(b)

Fig. 16. (a) (Patient No. 5, Ro . . .) Bilateral subtotal adrenalectomy. No sudation of the toes five years after lumbar sympathectomy. (b) (Patient No. 5) Hyper-sudation of fingers (non-sympathectomized).

(c) One would say that the taking of one or two tablets of cortisone is not a real inconvenience; still, it is better to do without it. Only very occasionally do three patients out of ten have to take a minimal dose; only their follow-up will allow us to decide.

We have collected in recent literature 61 cases of thromboangiostosis treated by bilateral adrenalectomy (total or sub-total) combined with a variable percentage of sympathectomies. Results are generally good in selected cases operated on early enough.

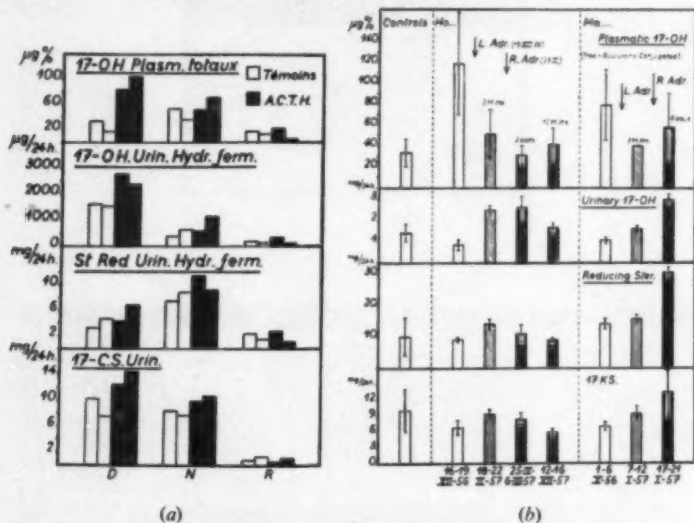


Fig. 17. (a) Variation of plasma and urine rates of corticosteroids during the two control days and during administration of ACTH (25 mg. in intravenous perfusion during six hours two consecutive days) in a control and in two patients with suprarenal deficiency. (b) Average rate of total plasma 17-hydroxycorticosteroids (free + glucurono-bound), of 17-hydroxycorticosteroids, of reductor steroids and of the urine 17-ketosteroids in controls and in patients with Buerger's disease. White columns correspond to average rates previous to any operation; hatched columns correspond to average variable delays after second suprarenalectomy.

Looking carefully through them, one can see that most failures occur in too advanced cases, almost ready for amputation; all operative deaths occurred in total bilateral adrenalectomies.

Table I shows the full list of the 13 patients operated on (39 sympathetic operations, 23 adrenalectomies); all are well proven cases of Buerger's disease; all are still alive. Actually, patient No. 13 should be considered apart. We saw him 10 years after the first outbreak of gangrene. Three years after amputation of the foot, there was no return of the blood in the main vessels below the obliterations. As a matter of fact, he should



# NEW TRENDS IN THE TREATMENT OF THROMBOANGIEIOSIS

not have been operated on at all, but he insisted on something being done to relieve the torture. Since then he has had two more amputations, but the pain has lessened a good deal and he does not receive morphia any more.

The first group consists of unilateral adrenalectomies.

No. 1. When admitted 11 years ago had pre-gangrene of the right big toe, and he had been sleeping with his feet hanging down for six months previous to the operation.

No. 2. Treated ten years ago as an emergency case screaming with pain in the left hand. There was ulceration of the third left toe.

No. 3. A Jewish doctor, treated for years for confirmed gangrene of the big left toe, although I believe he should be operated on for the right foot, at least.

These three patients are doing well, and do not wish for a further operation.

All the others are bilateral adrenalectomies (sub-total, 6/7 gr. of right gland remaining): seven patients out of nine, under normal circumstances, do not take any more cortisone; No. 4 will be taken off it this month. No. 10 is the only patient who will still receive cortisone, for steroid dosage has shown that the remanant of gland very likely does not secrete at all.

No. 9. Was a very indocile patient. When we managed to see him again 10 months after the second adrenalectomy, he was taking erratic doses of cortisone, and had developed tuberculosis, which responded well to treatment. He was able to undergo a lumbar and two upper thoracic sympathectomies a few months later. Now, he seems cured.

On admission, all patients but one had ulcerations somewhere. All had vascular trouble in the lower limbs, seven out of 12 had signs of involvement of the upper extremities (Table II).

Table III shows the surprising effects of the second adrenalectomy on the pain, within a few hours after operation. Eight patients out of 10 spontaneously said the pain had gone. Another inexplicable fact is that

TABLE III

Names		Modifications following the <u>Second Adrenalectomy</u>
4.	Lam.	Terebrating rest pain has disappeared in both feet.
5.	Rot.	Pain and cramps in left and right legs gone.
6.	Pro.	Disappearance of pain in left foot.
7.	Mar.	Disappearance of pain in right lower limb of six months' duration (non-sympathectomized side).
8.	Thi.	Disappearance of pain and swelling in the left upper limb (non-sympathectomized).
9.	Hol.	Complete disappearance of pain in the lower limbs, though the right lower limb was not sympathectomized.
10.	Bat.	Feels very depressed (due to total adrenalectomy).
11.	Moe.	No change.
12.	Ste.	No more pain in the right leg. No more cramps in the left leg.
13.	Lem.	Total suppression of pain in both lower limbs.
SUMMARY		Out of 10 cases—eight patients felt a definite improvement after the second adrenalectomy. Five patients (Ste., Lam., Hol., Pro., Lem.) had pain in sympathectomized limbs which was relieved by adrenalectomy.

the same improvement was observed in limbs not relieved by a previous sympathectomy!

TABLE IV

SWEAT TEST (Feb. 1960) (Ninhydrine reaction)		TEMPERATURE (Feb. 1960) (Centigrade)		
		UPPER LIMBS		LOWER LIMBS
		L	R	Temp. (1st toe — 2nd finger)
M O N O L A T	1. Deb.	+	Temp. 28.2	Temp. 29.9
	2. Sac.	+	+	S. Oct. 49
	3. Pid.	S. May 50	S. Jan. 53	S. Dec. 50
		+	+	+
B I L A T E R A L	4. Lam.	+	Temp. 27	Temp. 29.3
	5. Rot.	S. May 59	S. Aug. 59	S. Apr. 49
		+	+	S. Mar. 55
	7. Mar.	+	Temp. 32.8	S. May 57
	8. Thi.	S. Aug. 56	S. Jul. 56	S. Dec. 56
	9. Hol.	S. Sep. 59	S. May 59	S. Mar. 58
	10. Bat.	S. Jan. 60	S. Oct. 58	+
	11. Moe.	S. Nov. 57	S. Jan. 58	+
		+	+	S. Dec. 57
	12. Ste.	+	Temp. 31.2	S. Dec. 59
			34.3	S. Apr. 58
	13. Lem.	S. Mar. 59	S. Dec. 59	S. Dec. 59
		Temp. 29.6	S. Apr. 58	Temp. 29.2

S. : Sympathetomized

++ : heavy sweating

+ : sweating

± : traces

- : absence of sudation

Table IV demonstrates the sweating test recorded quite recently; it shows very clearly that in our series the effects of sympathectomy are amazingly prolonged: seven patients still have a temperature of 30° C. (normal) or more at all four extremities (Figs. 12 and 13). Of 37 sympathectomized limbs, only one sweats almost normally, and five exhibit traces of sudation. I earnestly think that these observations will call for further comments on the efficacy of sympathectomy and perhaps too

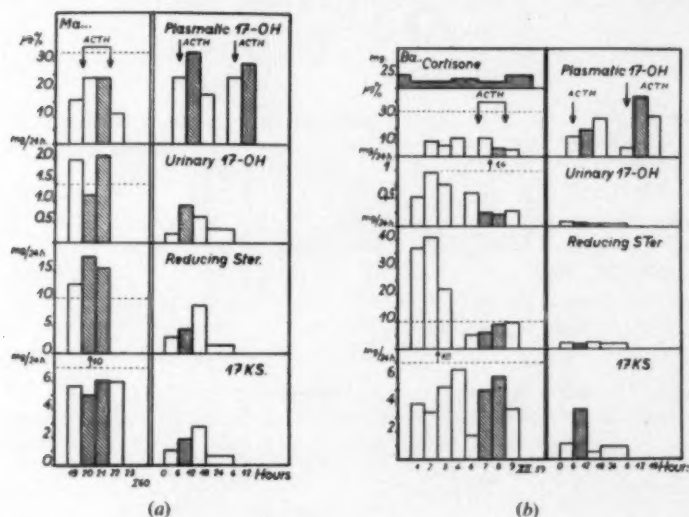


Fig. 18. (a) (Refers to case No. 7, see Table I.) Corticosteroids output three years after second subtotal adrenalectomy. Similar results have been found in all patients treated by the technique described. As in preceding figures, the left part of the slide corresponds to dosages done during the 48-hour test intravenous perfusion of ACTH two consecutive days, with collection of urines over 24 hours, and blood sampling every morning on fasting patients. White columns correspond to periods before and after ACTH perfusions and hatched columns to the two days during perfusion. On the right part of the illustration are shown the results of six-hour tests, and the urines collected every six hours before and during the eighteen hours following ACTH perfusion (white column), and during this perfusion (hatched column). Blood samplings are done immediately before the perfusion and six hours after (white columns), as well as at the end of the perfusion. The dotted line corresponds to the average rate observed in the controls. Attention is drawn in this figure to the increase of corticoiduria on the second day of the 48-hour test and to the transitory increase of corticoidaemia during the six-hour test. (b) (Patient No. 10, see Table I.) In this case, cortisone could not be taken off because of an involuntary total adrenalectomy. Daily dose administered is shown on the top left. Administration of ACTH induces no significant increase of corticoiduria or of basal corticoidaemia during the 48-hour test. During the six-hour test, no significant increase of urinary steroids is seen. After second ACTH perfusion, there is a very slight increase of corticoidaemia.

TABLE V

Names	Weight (Kgs.)		Cortisone Daily intake	Profession	Working capacity
	Before operation	Present			
1. Deb.		65.5 (Feb. 60)		Decorator	full
2. Sac.	78 (Jan. 53)	81.5 (Jan. 60)		Carpenter	full
3. Pid.	75 $\pm$ (Dec. 56)	74.5 (Feb. 60)		Doctor	full
4. Lam. Rot.	63 (Apr. 49) 55 (Jun. 55)	81 (Aug. 59) 65 (Jan. 60)	Hydrocort. 10 mg. none (occasionally) Hydrocort. 10 mg.)	Post clerk Workman (scrap iron)	full full
6. Pro. Mar.	60 (Nov. 57) 59 (Jul. 57)	66 (Apr. 58) 62 (Jan. 60)	none (occasionally) Hydrocort. 10 mg.)	Shop assistant Test driver	full full
8. Thi.	85 (Jan. 57)	98 (Jan. 60)	none (occasionally) Hydrocort. 10 mg.)	Workman (electric soldering)	full
9. Hol. Bat.	72 (Dec. 57) 72 (Jan. 58)	84 (Jan. 60) 69 (Nov. 59)	none Cortisone 25 mg.	Workman Forester	reduced full
11. Moe. Ste.	62.5 (Jan. 57) 80 (Apr. 58)	70 (Feb. 60) 83.5 (Feb. 60)	none none	Bookbinder Workman	reduced

MONOLAT

BILLATER

on the means of improving it with adrenalectomies (Figs. 14 (a) and (b), 15, 16). One patient, No. 10, had lost weight (7 lb.); he is the one who had an involuntary total adrenalectomy. All the others had put on weight (10 to 20 lb.). All patients, except No. 2, have resumed their previous occupations (Table V).

#### Conclusions (of steroid dosage) (Fig. 17 (a)).

1. In cases in which we are able to have analyses done before adrenal-ectomies, there is a tremendous increase of 17-OH steroids (three to four times more than normal); unfortunately the figures are too few in number to be statistically valid (Fig. 17 (b)).

2. In all cases tested after sub-total adrenalectomies, 17-OH steroids and 17-ketosteroids have been found permanently well under the mean concentration (Fig. 18 (a)).

3. After adrenalectomies, repeated and prolonged dosages have shown that ACTH stimulation cannot increase 17-OH steroids and 17-keto-steroids up to a subnormal level. This is evidence that the secretory potentialities of the minute fragment left behind ( $\frac{1}{2}$  gr.) is really minimal, just enough to maintain the patient's balance, and it is very likely in-nocuous (Fig. 18 (b)).

4. Even after a few years' follow-up, we have registered neither chemical nor clinical signs of compensatory hypersecretion of the residual fragment of the adrenal.

#### Results

None of the 12 patients considered has developed new outbreaks of gangrene at all; except for two toes ready to separate on admission (1950-1956), no amputation was required. Acrospasms have disappeared, pain has gone, ulcerations healed within a few weeks. The 12 of them had intermittent claudication before operation; now, five are still complaining of it when they walk briskly; seven can walk almost normally. All have put on weight; nine have returned to their previous occupations; three are still smoking. Only one mentioned "dry intercourse". They did not have any sympathetic neuralgia.

#### Conclusions

As for many other diseases, we are still at a loss to understand the causes of thromboangioidosis. Apparently, the summing up of pathological, experimental and clinical facts seems to purport that adrenals are one of the links in the pathogenesis of Buerger's disease. So far, bilateral adrenalectomy (even sub-total), combined with extensive sympathectomy, appears to have fully relieved patients for some time.

I want to make it clear that the follow-up has been short, and that these results may be challenged. We know that our point of view may be shaken by further observation; yet this is a dreadful disease, and it is worth while repeating experiments.

I would like to thank you once again for the great honour you have done me, and for the patience and attention with which you have listened to my talk.

### ACKNOWLEDGMENTS

I wish to acknowledge with thanks the personal reports and valuable comments I received from Aimes (Montpellier), Delannoy (Lille), Ferrand (Alger), Fontaine (Strasbourg), Govaerts (Bruxelles), Kunlin (Paris), Pettinari (Padova), Tinguad (Bordeaux) and Wertheimer (Lyon).

We are also indebted to our friends and colleagues, Betz, Lecomte, Moureau, Van Cauwenberghe, for their advice and collaboration.

Finally, special appreciation is extended to my assistant, L. van de Berg, for the great care he took following up the patients.

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### HONOURS CONFERRED ON FELLOWS AND MEMBERS

IN THE RECENT New Year Honours List the following Fellows and Members were graciously honoured by Her Majesty The Queen.

DENIS JOHN BROWNE, F.R.C.S.	K.C.V.O.
CHRISTOPHER HOWARD ANDREWES, F.R.S., M.D., F.R.C.P., M.R.C.S.	Knight Bachelor
BRIAN WELLINGHAM WINDEYER, F.R.C.S., F.R.C.S. Ed., F.F.R.	" "
JAMES CECIL HOGG, F.R.C.S.	C.V.O.
FRANK LEO HUTTER, F.R.C.S.	C.B.E. (Milit.)
RONALD BRAMBLE GREEN, F.R.C.S.	C.B.E. (Civil)
CHARLES HORNER GREEN MACAFEE, F.R.C.S.	" "
HARVIE KENNARD SNELL, M.D., M.R.C.S.	" "
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ARTHUR WARRINER WILLIAMS, M.D., F.R.C.P., M.R.C.S.	" "
ARTHUR GORDON WATERMAN BRANCH, M.D., M.R.C.S.	O.B.E. (Civil)
RONALD GEORGE GIBSON, M.R.C.S.	" "
RONALD BRODIE HEISCH, M.D., M.R.C.S.	" "
JOHN LEWIN, F.R.C.S., J.P.	" "
KEITH DIGBY YOUNG, M.R.C.S.	" "
THOMAS TURNER, V.R.D., M.R.C.S.	M.B.E. (Civil)

### APPOINTMENT OF FELLOWS AND MEMBERS TO CONSULTANT POSTS

R. B. CHATTOPADYAYA, F.R.C.S.	Reader in Surgery, Calcutta Medical College.
D. P. GREAVES, F.R.C.S.	Consultant Ophthalmologist, Moorfields Eye Hospital.
R. J. H. SMITH, F.R.C.S.	Consultant Ophthalmologist, Moorfields Eye Hospital.
P. D. TREVOR-ROPER, F.R.C.S.	Consultant Ophthalmologist, Moorfields Eye Hospital.

## ARM PROSTHESES AND APPLIANCES — THEIR FUNCTIONAL VALUE IN INDUSTRY

Joseph Henry Lecture delivered at the Royal College of Surgeons of England

on

14th April 1960

by

Leon Gillis, M.B.E., M.Ch., F.R.C.S.

Consultant Surgeon, Queen Mary's (Roehampton) Hospital, East Ham Memorial  
Hospital and St. John's Hospital, London

THIS MIGHT WELL be called a memorial lecture. We mourn the passing, but two months ago, of the Founder of this lecture—Sidney Alexander Henry. In actual fact, he dedicated this lecture to honour and cherish the memory of his father. Let me say a word about the Founder.

His whole life was devoted to and consumed by a passionate study of the diseases of occupation and their hazards. His greatest interest was in occupational cancer, and many of his long list of publications are on this subject.

His book on *Cancer of the Scrotum in relation to Occupation* (1946) showed his meticulous attention to detail and his persistence in stressing the occupational histories of people who had died from the disease.

Joseph Henry, his father, was born at Clones, Co. Monaghan, Ireland, on the 9th May 1852. He received his medical education at Queen's University, Belfast, settled in Rochdale, Lancashire, as a general practitioner, and was also Medical Officer of Health for the Borough from October 1879 to 1908. He died in Rochdale on 30th September 1919.

This is a world of changing values. It is a paradox of this age that, with human life frail and at the mercy of the whims and the barbarity of the atom bomb, mankind should endeavour to strive more and more to mend the maimed and restore useful lives and return them to happiness and full work.

To lose a limb is, of course, a tragedy, but man with his innate optimism can overcome and conquer. He does, however, need—in particular in the initial stages of his disability—our full assistance.

A striking change has taken place in the attitude of society towards those who are unfortunate enough to lose a limb. They now return to industry. Medicine has no frontiers and does not end with the surgeon's work at the operating table.

At the end of the 18th century, 1795 to be precise, there was born in Leeds a man who will always be considered as a pioneer of industrial

LEON GILLIS

medicine in England, namely, Charles Turner Thackrah, who in 1831 wrote a book on the *Needs of the Principal Arts, Trades and Professions*. Unfortunately he died in 1833, too soon to see the effect of the factory legislation which only came into force that year.

It was part of the function of medicine, he said, "to make a contribution not only to the well being of workers, but also to see to it, so far as possible, that they should exercise their callings without harm"—so I and my colleagues study the mysteries of the mechanic art and do what we can to



*Reproduced from "Arm Prostheses and Appliances" by kind permission of Mr. R. Langdale Kelham and the Controller of H.M. Stationery Office.*

Fig. 1. A pencil sketch drawn unaided by a patient who is a double above-elbow amputee, using his artificial arm.

restore those who have been maimed, and to return them to industry so that they lead normal lives.

Man's increasing pre-eminence over his natural environment has been ascribed to three specific characteristics: a highly developed brain, binocular vision, and an apposable thumb. These three attributes have enabled him to adapt himself to a varying physical environment to suit his needs. Loss of any one of these three fundamental human capacities handicaps him, and curtails his ability to manipulate the objective world around him.

An impaired brain function is often irreversible. Loss of vision is obviously a disaster and requires great efforts on everybody's part for even a moderate degree of functional restitution.

Figure 1 is a pencil sketch drawn unaided by a patient who is a double above-elbow amputee, and he used his artificial arms.

Fortunately, the situation is somewhat different today with respect to the loss of the hand. Before expanding on this, my theme of the advances in arm prostheses, it is important to preserve a sense of proportion and dwell for a moment on the incomparable virtues of this matchless device—the human hand.

The hand is capable of moving accurately to any point; of varying quantity and quality of this motion, with marvellous precision. Through the disciplines of habit and practice, complex movement patterns become elaborated and perfected and their constancy treasured upon the tablets of man's memory.

It is in the craft of painters, musicians, sculptors and technicians (and surgeons—dare I say?) that we see the full flower of man's handiwork, and something of the mystery and potential of this priceless mechanism stands revealed. The variety and intricacy of manual dexterity lie beyond description.

Now writing is one of the simplest of skills, and yet in the formation of every written character there is focussed a minute development of force that has variables of intensity, direction and duration; all these are exactly remembered and reproduced without change of line or stroke, even should sight be denied.

The hand serves further as a probe, to measure the degrees of the hardness or softness of objects and the texture of their surfaces; as a balance to compare their weights; as a thermometer to estimate their temperature—of very great importance to the blind.

This inimitable mechanism enables one to place one's hand where required in space within very wide limits. When so placed the hand and fingers can perform work of a vigorous or precise nature.

Amputation of the hand deprives the patient of his most important "receiver" for his sense of touch. No mechanical device has as yet made good this loss.

Artificial arms of varying degrees of complexity have been produced, but, in practice, it is the simpler devices which gain greatest acceptance and functional value.

As a result of systematic and concerted efforts in surgery and engineering the limitations imposed by the loss of an arm have gradually been reduced.

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New conceptions and developments in the fields of surgery and limb prosthetics have increased the potentialities of arm amputees. The ill winds of destruction blow fresh breezes which stimulate construction.

For many years amputations were largely the aftermath of wars. However, owing to the increase in industrialization and road traffic during the past 20-30 years, coupled with a higher average expectancy of life which has resulted from advances in medical knowledge and the development of geriatrics, the problem of amputation stumps is now occupying an increasingly important place in peace-time surgery.

The population of Great Britain may be taken as 50 million. There are about 20 million workers, with potentially 6,000 million working days annually.

Working days lost annually —

3½	million in	Strikes
18	"	in Accidents
280	"	in Sickness

These include only notifiable absences.

At any given time, one million men are away from work through sickness.

One third to one fourth of all sickness causing industrial absences is psychological. The cost to the country of men changing from one job to another is £700 million per annum. It is therefore of great importance to say what job a man can do. This applies, of course, to all workers, but is especially important and quite feasible in the case of an amputee.

At Roehampton, Kelham's analysis of the records of 1,000 arm cases showed how arm amputees were employed.

*Above-elbow arm amputees:* 48 per cent. returned to the same work; 32 per cent. obtained more remunerative work; 20 per cent. obtained less remunerative work.

*Below-elbow arm amputees:* 42 per cent. returned to the same occupation; 42 per cent. obtained more remunerative work; 16 per cent. obtained less remunerative work.

These figures show not only what a fair chance the arm amputee has to-day to remain in gainful employment, but also how a worker's earnings can be improved by assessment, careful training and suitable placing.

An arm prosthesis in above-elbow amputation consists of a socket for the stump and three members representing the upper arm, forearm and hand or terminal device respectively. The socket forms the upper section of the stump and is enclosed in it.



The natural elbow is replaced by mechanisms, providing—

- (a) Rotation about the long axis of the upper arm, resisted by spring-loaded spherical bearings or by friction. There may, in addition, be a mechanical lock.
- (b) Rotation about an axis at right angles to the above provides the flexion-extension movement of the forearm. This movement is furnished with a voluntarily operated mechanical lock in certain predetermined positions.

The forearm section carries a means for mounting a terminal device at its distal end or alternatively at mid-forearm. In Great Britain we use a wrist rotary mechanism which provides rotation of the terminal device



Fig. 2. Child with right above-elbow amputation and a partially mutilated hand on the left, drawing with pencil in a split hook.



Fig. 3. A left below-elbow amputee using a split hook for household tasks.

about the axis of the forearm, resisted by spring-loaded spherical bearings engaging with a series of holes, and so fixing the device in a series of set positions with, in addition, a manually operated bolt which locks the device in selected positions of rotation. It allows quick insertion and replacement of terminal devices.

There is a considerable range of terminal devices. They include passive hands, mechanical hands, split hooks of diverse shapes and sizes, and a great variety of special tools such as welding appliances, saw and plane holders, and so on. The special appliances are designed to assist the amputee to earn his living in competition with normal people. Most patients elect to use a hand for social occasions and exchange it for one or more of the functional terminal devices for work, hobbies, etc. (Figs. 2 and 3).

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For many years the general purpose prehension appliance has been the split hook and nothing yet in sight is likely to supersede it. Attempts to produce a mechanical hand which will combine the usefulness of a split hook with a more natural appearance have resulted in necessarily more elaborate, heavier mechanisms, and function that is generally less good because they are relatively clumsy and will not stand up to heavy usage. It is necessary to wear a glove for cosmetic reasons which further impairs function. In America much money has been spent developing a polyvinylchloride glove, which is practically a facsimile of the natural hand,



Fig. 4. A right-handed draughtsman successfully rehabilitated after a right below-elbow amputation.

but it lacks durability and tends to become easily soiled, looks cadaverous and loses its colour, which calls attention to the disablement. Acrylates are also being tried for this purpose.

The power for operating these devices is derived mainly from the movements such as rounding and hunching the shoulders which activate thongs attached to appendages running from the opposite shoulder to the appliances (or fingers) (Fig. 4). They act against the thrust of the stump in the socket.

In Germany a compressed carbon dioxide motor has been developed, the control valves being strapped to residual stump muscles, so that prosthetic movements are initiated by synergic muscles. An electrical

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arm has been developed in America, and an electric hand in France, and British, Russian and American experimenters have shown that it is possible to amplify the electrical discharges which occur in muscles to activate mechanisms. All these devices introduce complications. There may, nevertheless, some day be found a use for such auxiliary motors for the most severely disabled.

The harness (Fig. 5) suspends the artificial arm and provides for—

- (a) operation of the terminal appliance
- (b) flexing the artificial elbow joint
- (c) operating the elbow joint flexion lock.

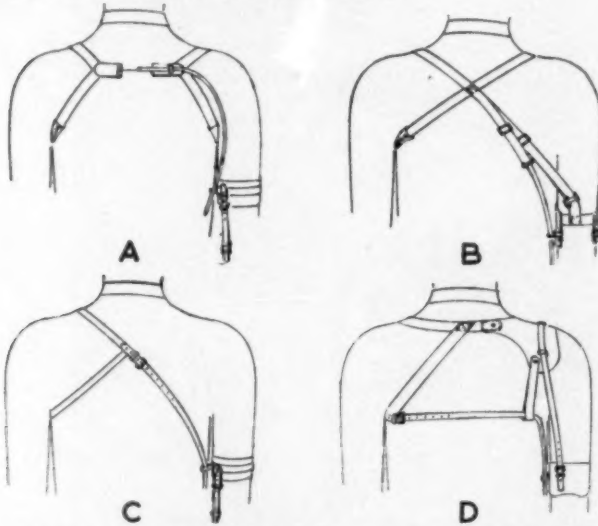


Fig. 5. Operating cords for below-elbow arms. (a) Bowden cable operating cord attached to appendage for use with hand prosthesis working appliance. (b) Operating cord for use with non-corset appendage. (c) Operating cord with leather shoulder loop for use with upper arm corset or narrow upper-arm band only. (d) Operating cord for use with saddle appendage.

It is possible to give separate control to each of the above movements. On the other hand a common appendage, using the same source of power for flexion and terminal appliance operation when the elbow is simultaneously locked, can transmit its pull to the split hook. This "dual control" is easier to learn and manipulate than three separate controls for most purposes.

Children are now being fitted at a very early age. Recent experience has shown that if a child is fitted with a simple prosthesis at about the age of two (years) it will definitely accept the "limb", but if no

prosthesis is applied before the age of 10 (years) the child rarely accepts it. Although the normal infant's hand has a certain grasping function, a simple hand which can be used as a "pusher" meets early needs. But this simple device must be changed for a miniature split hook as soon as co-ordinated prehension begins. A child will usually accept a split hook before the age of four and finds it of functional value. This naturally depends on the child's intelligence and development.

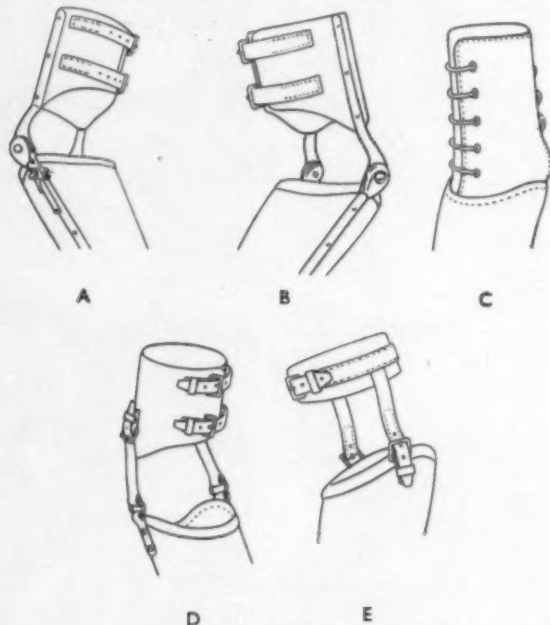


Fig. 6. Alternative corset attachments for below-elbow and disarticulation of the wrist amputations. (a) Corset with articulated side steels and elbow lock. (b) Corset with articulated side steels. (c) Corset stitched direct to socket. (d) Corset with side suspension straps. (e) Narrow arm band with side suspension straps. With (a), (b) and (d) a saddle appendage is generally used. Where the length of the stump and the surgical conditions permit, a non-corset appendage has advantages over corset attachments.

Arms for bilateral amputees (Fig. 8) are essentially similar with modification only of the appendage to provide for bilateral controls. When so equipped the amputee should become independent of outside help and capable of gainful occupation, and not become a burden on society even if congenitally disabled. Because necessity is the mother of invention, the efficiency attained by the bilateral amputee is a never-ending source of wonder.

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Future progress is likely to be in the direction of improved fit and efficiency of the present conventional arm rather than in increased mechanical elaboration. Devices with mechanical motors may have application to special cases, though they still require much development.

The prosthesis has to replace an anatomical component, but it does not necessarily follow that its mechanical design should copy that of the part it replaces. Amputation often changes the pattern of muscular control. But whatever form the substitute takes it should be comfortable, useful,



Fig. 7. A young lady knitting with the aid of a split hook in a left below-elbow prosthesis.

and of satisfactory appearance. The emphasis placed on the three factors may vary with individual patients and with different occupations.

The fitting of an artificial arm is necessarily an individual problem, but certain broad classifications can be made in relation to the level of amputation in that the mechanical problem is essentially conditioned by the level of amputation.

Special problems will arise in —

1. Special occupations, e.g., car drivers, aeroplane pilots.
2. Children require special consideration in view of their rapid growth. Conical stump. Advice.

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3. With congenital or acquired defects an individual problem arises because of the absence of uniformity.

4. Lastly, the aged and those with multiple handicaps may not have the physique to control conventional prostheses and require special consideration.

Successful rehabilitation of the arm amputee which enables him to re-enter industry depends upon a number of factors. I shall now consider—

- (a) The surgery of arm amputations.
- (b) Physical preparation of the stump.
- (c) Selection of the right type of arm and appliances.
- (d) Training in the use of the limb.
- (e) Raising of morale and briefing as to the future. (Social therapy.)



Fig. 8. A double below-elbow amputee using knife and fork in split hooks (with temporary artificial arms).



- (f) Correct job placement.
- (g) Vocational training when required.

**(a) The surgery of arm amputations (Fig. 9)**

Well planned thoughtful surgery is important. Whilst artificial arms are designed and fitted to any amputation stump from a forequarter to a mutilated hand, the best results are to be expected where there is a good functional stump, that is, an ideal above or below elbow stump. The longer the stump, the better the leverage, but very long stumps are liable to circulatory defects and this implies that the best stump is, as regards length, a compromise between the mechanical and physiological requirements; 8 ins. from the acromion for a humeral stump, and 7 ins. from the olecranon for a forearm stump is advised for adults. In other words, in an above-elbow stump there should be about 5 ins. of clearance from the distal end of the stump to the level of the other elbow joint in order to have

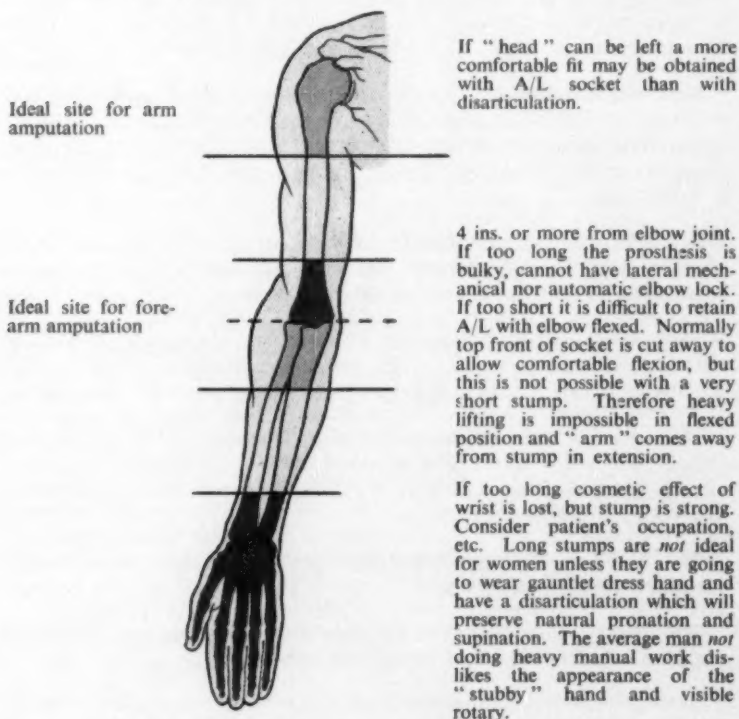


Fig. 9. Amputation levels now useful for prosthetic purposes.

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sufficient space to insert an automatic elbow unit. In a below-elbow stump it is necessary to have about 2 ins. from the distal end of the stump to the level of the normal wrist joint, so that an artificial wrist mechanism can be inserted. The length of the stump should, as far as possible, comply with these measurements, but in the case of blind people, especially bilateral amputees, the long stump is an advantage, to some extent it helps to assist with their lost sight. It acts as an antenna.

In deciding whether to amputate we take cognizance of the advances in vascular surgery, for it is the vascular injury that so often dictates an amputation. There can be no doubt about it there is a certain reluctance to embark on a vascular procedure when the patient is already grimly ill, say with fractures, but I would stress that particularly in the fractured femur, the dislocated knee, the severe fracture dislocation of the elbow and forearm, if the distal pulses have disappeared and there is ischaemia, amputation, possibly preceded by arteriography, may be the decision. A fact very often overlooked is that the collateral vessels of the limb may be damaged by the disruption of the fracture, and if in addition there is also damage to the main vessel, distal limb survival is impossible.

Resist the temptation of a formal amputation as a primary procedure. Amputate as low down as possible and conserve, especially in the upper limb. By conservative surgery there is no added hazard of gas gangrene, especially in the forearm and hand. Revision can always be undertaken at a later date.

I have tried to conserve natural joints as much as possible, and in an effort to utilize the patient's own remaining muscular power I have made false joints. I did this by a variety of techniques.

They essentially have been to very little purpose, and I prefer, and would reiterate to the point of tedium, the importance of preserving as much as possible of the length of the limb by vascular surgery and by skin grafting.

*Technique.*—I still feel, as in the days of Larrey, that the simplest technique is the method of choice, and even in the most advantageous circumstances the emphasis is on simplicity as the prime requirement in operations involving amputation.

To provide the best possible stump the standard principles of careful surgical technique are essential.

Bone lengths should be sacrificed only if there is inadequate soft tissue covering. Tactile skin is of paramount importance.

Saving skin with questionable circulation or without sensation is usually of little value.

If the tissue is badly traumatized, or the danger of infection is great, flaps should still be cut and a formal amputation be performed, but the wound should not be tightly sealed with sutures.

Modern antibiotics help to avoid grave infections.

If these principles are not adhered to, open amputations yield a considerable amount of scar tissue in the healing process. The skin is papery, ulcerates easily and never stands up to limb wearing.

When a guillotine amputation has been performed a careful revision is necessary with removal of all the scar tissue and some further sacrifice of bone length at a later date.

Healing by primary intention is ideal. Areas which heal by delayed union may break down at a later stage. Almost every case of ulceration or difficulty with the scar can be traced to a failure of primary healing.

Difficulties in prosthetic fitting may be encountered if redundant tissue is present. Scars which adhere to the bone will give difficulty in fitting, and can be a source of future trouble for the amputee.

The present artificial arm for disarticulation of the elbow joint and for long above-elbow stumps is not as efficient as an artificial limb which is made for the ideal above-elbow stump because there is no lateral mechanism or automatic lock that can be adapted, and the patient in these circumstances is worse off.

The through wrist amputation has some advantage in that it does preserve pronation and supination movements, but the present working arm does not allow full use to be made of these movements. However, the fault is in the design of the artificial limb and work is in process to rectify this. This prosthesis is necessarily bulky and unsightly, and the hand is certainly not acceptable to women and to many men.

In under-developed countries, where artificial limbs are unlikely to be available, disarticulation of the wrist has a place.

We must remember, too, that the musculature of a stump at the time of operation loses its terminal sense organ—the distal limb. It retracts and by doing so loses the capacity for active work, stretching and contracting. The cessation of the muscular pumping action causes venous stasis, together with the ischaemic syndrome at the stump end, leading clinically to coldness, a bluish tinge, keratosis and papillomatous lesions and ulceration, histologically to atrophy, fatty degeneration, haemosiderin deposits and fibrosis.

Loss of muscle contraction leads to failure of "spill over" to the skin, as in the poliomyelitis limb. It is often overlooked that this produces

ischaemic neuritis and that this anoxic pain is different from the ordinary neuroma lesion. Consequently, operations on the peripheral nervous system in the presence of these changes are unsuccessful.

We are in the process of doing some re-thinking as to the present practice of leaving divided muscles quivering in their sheaths, forlorn and alone. Their reattachment to their bedfellows is important.

I now reaffix the cut end of the muscles in such a way that they may still be able to contract to their optimum extent and also control particularly the end of the stump. This enables the fasciculi of the muscles to resume their ability to exert force and their capacity for useful work.

The antagonistic groups of muscle activate each other, and the tension restores their normal tone whilst the use of a prosthesis is facilitated. This does not lead to the formation of a globular bulge as commonly imagined.

The unsteady quivering mass movement in the soft tissues of a "fleshy" stump in which the muscles have not been fixed adds to the difficulty of stump management, and is probably one of the causes of the "painful ischaemic syndrome" of the stump ending.

Divided nerves seldom give trouble if they are divided above the level of the end of the stump and allowed to retract. A severed nerve will form a neuroma, which is moderately tender to pressure, particularly in the first year or two after amputation. This "neuroma" as we call it is not a pathological entity and will cause difficulty in the amputation stump only if it is located in an area which will receive pressure or be subjected to traction.

#### **(b) Physical preparation of the stump**

Physiotherapy is necessary for the exercising of stump muscles and mobilization of proximal joints. As soon as the stump is healed occupational therapy becomes essential. A leather or canvas gauntlet should be applied to the stump (above or below elbow, right or left) and the patient instructed in its use within about 24 hours.

The gauntlet straps hold a spoon or fork or pencil, etc., and the patient should be encouraged to feed himself and write, and thus appreciate the fact that the stump is useful and will become more so with practice. This also exercises the stump and helps to retain movement patterns which aid training.

A patient who has had a good continuous post-operative training will be much easier to train in the "Arm Training School". He will retain a bimanual attitude and will soon develop the idea of independence which is a pronounced characteristic of all amputees once they begin to recover from the idea of crippleddom.

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When the patient is able to visit the Limb Fitting Centre he can often be fitted with a temporary arm, to the end of which is applied a mechanism for the attachments of appliances which he uses until the permanent arm is made.

The longer the interval between amputation and limb fitting the more one-handed the patient becomes.

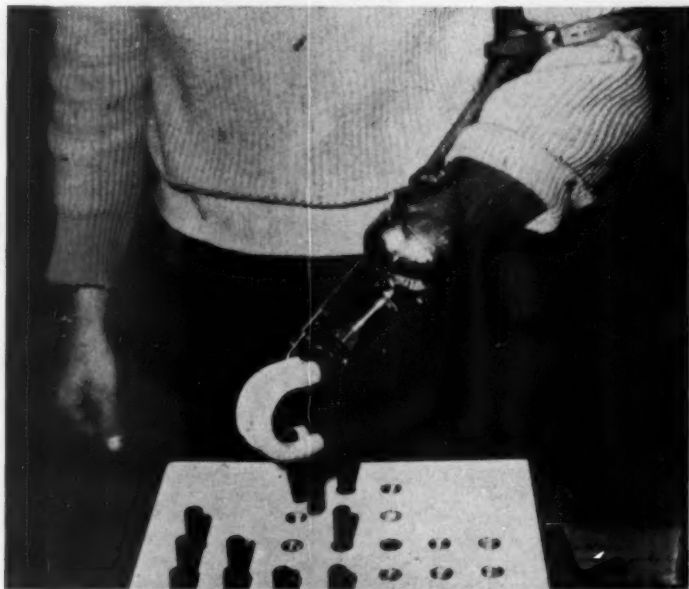


Fig. 10. A man with no fingers using a split hook in an ugly working prosthesis for a partially mutilated hand. (This is cumbersome and far less efficient than an artificial arm for a mid-forearm amputation.)

#### (c) Selection of the right type of arm and appliances

The selection of the best type of arm, of which there are many varieties, is of great importance. Any error in selection may well retard rehabilitation. Arms are available for every level of amputation and are made in three classes.

##### *Functional classification of artificial arms*

1. Arm for heavy work.
2. Arm for light work.
3. Dress or cosmetic arm.

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The latter are of little functional value and are not prescribed except for some fore-quarter and disarticulation at the shoulder joint cases, for some women and very aged patients. Some patients will say, "I only want an arm to fill the sleeve"; but that is so only because they have not been properly briefed as to the value of an arm and they should be discouraged in their desire for a purely dress arm.



Fig. 11. A boy with left below-elbow amputation using a split hook for leather work.

In the same way, much consideration is needed as to the selection of suitable appliances to use with the arm.

There are in all about 140 different appliances available for use which are snapped into position and removed in a matter of a second or so. Some of them are multi-purpose appliances, but most are designed for specific purpose for use in industry and hobbies and sport. The patient



whilst in the Arm Training School will experiment with them and find out which suit him best.

Some appliances are for heavy work of a coarse nature, agriculture, etc., whilst others enable precision work to be undertaken. Despite the large number available it is found that usually a patient does not require more than four appliances by the time he has been trained.

**(d) Training in the use of the limb (Fig. 10)**

*Arm training.* To give an artificial arm to a patient without training in its use is like giving a child its first cycle without teaching or helping him to ride it—some will succeed but most will fail. All amputees should be persuaded to accept training which, unfortunately, is not a compulsory part of the rehabilitation. Thus we often find an arm amputee is offered work by his old employer, but it is often work of a lower standard because the employer does not know the capability of the trained arm user—he is influenced by the apparent disability rather than his potential ability.

In the Arm Schools, patients are not taught a trade, but are taught how to use the arm to the best advantage with the various appliances (Fig. 11). For this purpose patients engage in bimanual activities such as carpentry (some eventually have become cabinet makers), model making, the use of agricultural equipment, typing, writing, office work, and for women especially cooking, washing and ironing. Consideration should also be given to personal independence, i.e. dressing, washing, feeding and toilet, as this becomes important when employment is sought. During this period the patient discovers whether he can return to his old occupation if he so desires, or else forms ideas as to what he would like to do and discusses them with the disablement resettlement officer who, if necessary, will arrange for industrial training in a new trade.

**(e) Raising of the morale and briefing as to the future (social therapy)**

This is of paramount importance because all suffer to a greater or lesser degree according to personality and temperament through shock of the loss of a limb and require psychological adjustment.

This adjustment can best be effected by the approach of all those who form the Reablement Team. This team consists firstly of the nurses who are in most frequent contact with the patient, together with the doctors, physiotherapists, occupational-therapists, limb fitters, training instructors, almoners and welfare officers and finally the disablement resettlement officers.

The patient should be informed from the start as to what is going to be done for him and why and what the potential results are likely to be in each case. Reasoned optimism is essential, but extravagant optimistic

hopes for the future can only result in disappointment. Encouragement is needed and hope should be instilled for the future.

Patients can be told of the success achieved by those of similar age and physical and mental capacity in every walk of life.

The most convincing argument to the new amputee is to see others in a more advanced stage of rehabilitation, particularly those who have resumed a normal life and occupation.

It is always advisable to prepare patients for the fact that after amputation they may feel their feet and hands in phantom form which will be a somewhat different sensation from that of their normal limbs. They will become conscious of movement of the digits or a cramping sensation, or perhaps even tingling, but in a few months' time they will become accustomed to these strange sensations; ignore them and they will disappear. If such a warning is not given the patient may think when these sensations develop that something has gone wrong with the stump, and he begins to worry about a physiological sensation which may develop into one of a pathological nature.

Most arm amputees suffer mental shock from amputation and many tend to resign themselves to becoming one-hand or one-arm minded for the future. This factor is one which renders the rehabilitation of the arm amputee much more difficult than that of the lower extremity amputee.

A leg amputee is determined to, and does, get about somehow if only on crutches, whilst the arm amputee on the other hand has no natural inducement to make use of an artificial arm.

It is most important, therefore, that steps should be taken from the earliest moment after operation to convince the patient that though the hand be missing the stump remains an active member, capable of performing useful functions.

They must be convinced that with an artificial arm, and after training, they can compete on favourable terms with their sound fellow workers in most occupations.

Whilst the personality of the individual plays an important part and some will do better than others, the boosting of morale by those who are knowledgeable of the potentialities of the arm amputee is always desirable and will do much to ensure success.

#### **(f) Correct job placement**

If after fitting and arm training a patient either cannot or does not desire to return to the same work, and some take the opportunity of making a change, then a heavy responsibility rests upon the limb surgeon and the

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person responsible for arm training, and the disabled resettlement officer, in advising him as to the future.

To give this advice one must know the personality of the patient, his physical and mental condition, his capability with the arm and potentiality therewith, his interests and hopes and his adaptability, general education, etc. The work selected must be in an environment suitable to the case—for instance, a patient who lost his arm as a result of machine gun fire in the war wanted to be a mechanic, which he could well achieve, but he was put to work in a factory in which mechanical rivetting was being carried on: this reminded him constantly of the circumstances in which he lost his arm, with obvious results, until he was moved to a quieter workshop.

Broadly speaking it may be said that above-elbow cases, unless of exceptional ability or determination, do better in work involving coarser movements, whilst those with below-elbow stumps can engage in finer work and that entailing a degree of precision.

Records show that above-elbow cases are now engaged in such occupations as the following:

Agriculture	Lino workers
Boot repairing	Machinist
Carpentry and cabinet making	Postal workers
Clergymen	Sheep farming
Clerical work	Shop assistant
Comptometer operator	Typist
Engineering	Welding
Housewife	Wood turner

Below-elbow cases are found to be engaged in the following occupations in addition to the above:

Bank cashiers	Machine turners
Builders	Motor drivers
Builders and decorators	Motor mechanics
Chemists	Paper hangers
Crane drivers	Plumbing
Draughtsmen	Radio and television mechanics
French polishers	Upholsterers
Foundry workers	Wood machinists

besides many others.

### (g) Vocational training

In order to increase the country's industrial productivity, for those who have not been trained before, or in those cases where there is a change in the industrial needs of the community, it is essential and necessary to make the maximum use of those incapacitated by amputation. It is an essential also to the economy of the nation to rehabilitate these persons

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on the principle that it is better for them to take their place in society and industry and add to the national income than to let them continue to be consumers of tax funds and earnings of family and friends.

It should be borne in mind that to achieve these ends the surgeon's responsibility does not end with the healing of the wound. He must supervise the preparation of the stump for the prosthesis, but I appreciate that this is not always possible. He should be able to advise in the selection and fitting of the limb, and to do this intelligently he must be familiar



Fig. 12. Girl and boy cellists (in foreground) with left and right below-elbow prostheses playing in an orchestra. The girl has a short congenital below-elbow stump and the boy had a disarticulation of the wrist which has been converted into a below-elbow amputation.

with the standard types of artificial limbs and have some knowledge of the value of various materials used in their construction so that he may advise the amputee of the material best suited to his particular need. He need not have an intimate knowledge of the construction or of the joint control and mechanism, but he should be sufficiently familiar with such mechanisms to understand the basic principles of their function and control. Most important of all, he should possess sufficient knowledge of the principles of alignment and fitting to be able to inspect the limb after it has been fitted and to determine whether or not it fits well and functions properly.

## ARM PROSTHESES AND APPLIANCES — THEIR FUNCTIONAL VALUE IN INDUSTRY

In conclusion it can be said that given the right type of arm, a good stump, proper training and briefing and correct job placement, there would appear to be few limitations to the employment of an arm amputee in industry.

I have attempted to show you that the work of the surgeon does not end with the scalpel and the stitch. We treat not a mutilation, but a mutilated patient. To assess the patient's personality, to organize his social and occupational reabling is as important as the surgery itself. Indeed, in the language of Cushing, there is then a place for a surgeon verily without hands but with an understanding heart and a kind tongue.

I am grateful to my limb-fitting colleagues for the help they have given me in preparing this paper, and in particular to Dr. I. Fletcher for the loan of some of the photographs.

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PEARKES. *Diseases of literary and sedentary persons*. 1819. Gift of Dr. Harold Webb, M.R.C.S.  
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Additional Notes by S. Wood,

Library Assistant, Royal College of Surgeons of England

A NOTABLE ADDITION to the Library is a copy of William Maiden's *Account of a Case of Recovery, after an extraordinary Accident, by which the Shaft of a Chaise had been forced through the Thorax*, 4to, London, 1812, pp. 28, published by Bayley.

This pamphlet is a rarity; only three copies had been traced—in the British Museum, Royal College of Physicians, and the Royal Society—until a fourth was lately sent to this College by a private owner, and purchased. This is the more remarkable as it occurred coincidentally with a re-awakening of interest in the "Shaft Case", as it is called, and the arrival of proof-sheets of an article dealing with the accident and subsequent history of the patient, published in *Medical History*, July 1960.

The British Museum copy of the *Account*, published at 3s. 6d., is inscribed to "The Right Honble Joseph Banks, most respectfully, from the Author". The second edition—or impression—published in 1813, is similar to the first except that the sellers were different. There is a bound copy in the Royal College of Surgeons' Library; and another, as published, is included in the Owen Collection which came to the College in 1893. This "rare tract" as Owen describes it, is a 28-page quarto and is made up with paper of moderate quality in a plain brown-paper cover inside which is a yellow label printed "Prof. Rich. Owen, F.R.S. Sheen Lodge, Richmond Park, S.W." This copy belonged to Owen's father-in-law, Clift, whose original plan of the scene of the accident and a letter from Maiden are preserved within its covers. William Clift and Richard Owen were the first and second Conservators of the Hunterian Museum.

The "Re-publication" was issued in 1824 at 10s. 6d. with plates drawn by Clift showing anterior and posterior views of the patient's chest and the apertures through which the shaft penetrated the thorax. There is also the plan showing horse and chaise and stable, and a drawing, with measurements, of the shaft itself. The book is an unwieldy production, 1 ft. 2½ ins. high by 10½ ins. wide. The ordinary copies were in plain boards with paper back and label on the front cover. A generous margin accounts for the size, as the text, printed in great primer, measures only 7½ by 5¼ ins. Fifty copies were on "superior" paper in special binding by Wodderspoon and Shave, Searle Street, Lincoln's Inn, which was of half-calf with watered-green cloth sides and marbled end-papers. In the Library there



#### MR. TIPPLE'S CHEST WOUND

are four copies inscribed "With sincere regard of the Author" sent to Daniel Morgan (uncut), Edward Bean, Michael Bowman, and H. B. Hillier. A fifth copy, text only, is with the Maiden collection of letters. This wealth of copies may be explained by Clift's letter of 18 February 1824 in which a pencilled note appears: "Mr. Carpenter has printed 1000—fifty sets on superior paper".

The published plates of the wounded thorax are in black and white (Figs. 1 and 2), but in the Maiden collection there is evidence of an intention to produce them in colour. Clift has shown in a water-colour what he wished to see in the plates and some impressions were actually struck off but never published. Unfortunately there is no reference in the letters as to why the project was abandoned, but probably the cost was prohibitive.

#### The Maiden letters

A collection of letters in the College Library from September 1823 to July 1824 shows what happened behind the scenes during the preparation of the revised edition for which Sir William Blizard had written a short Commentary. In January 1824 Carpenter reported that he was prepared to publish as soon as the plates were finished by Mr. Basire. The question then arose as to who should print the plates, and Clift recommended Mr. Cox, Basire's uncle, a copper-plate printer of superior work "such as he produces for the Royal Society". Apparently an unusual type was used for the text, as Carpenter, the printer, said that he would be obliged to break up the type from sheet to sheet as he had not enough to set up the whole work at once.

An undated letter to Mr. Carpenter, Junior, contains an invitation to dinner at Maiden's house and to view the scene of the accident; the premises, near the "Eagle and Child", were now occupied by a Mr. Kain. The Clifts, being also invited, were advised to travel by Winch's Coach from the "Cock", Leadenhall Street, allowing three hours or more before dinner time which "on Sundays is at four, other days at five". Clift notes in his diary that he went on Sunday the 7th of March.

On 1st March 1824, the copper plates were ready for printing, and Maiden informed Clift that his plan of the accident "so neatly and correctly executed" had been sent off to be engraved, the horse to appear with his head towards the stable door. He also invited Clift and Carpenter to a family dinner to estimate the selling price of the book.

Two weeks later publication was well advanced but a new interest cropped up when Maiden reported the discovery of some fossils near Ilford. He believed them to be the jaw-bone with teeth of an elephant which were found 20 feet below the surface in very hard matrix, together with two large horns. He had already informed Blizard, who promised to take Clift to see the bones as soon as possible.

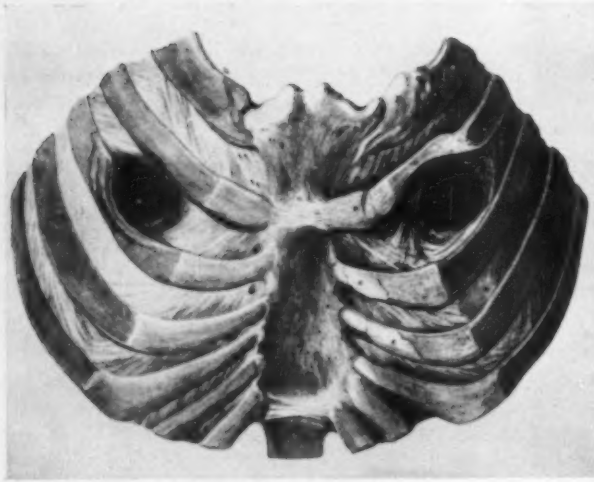


Fig. 1. Anterior view of the chest showing the injuries made by the shaft.

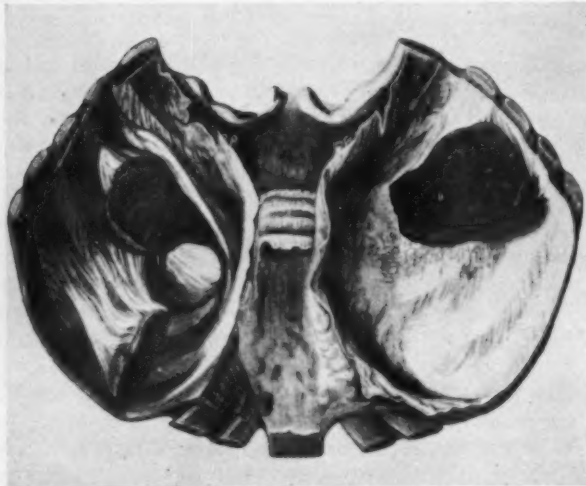


Fig. 2. Posterior view of the chest showing injuries made by the shaft.

# MR. TIPPLE'S CHEST WOUND

Maiden acknowledges Clift's very great attention in preparing the drawings and those for the original edition (Fig. 3); he is concerned that no acknowledgment was made at the time. However, he presented Clift with 40 copies of the book "to dispose of to your friends as some remuneration for your trouble—and I shall still be your debtor". Clift thinks ten would be sufficient to send to some friends and, in Maiden's name, one to the Royal Society and another to Sir Humphry Davy against his Saturday evening *Conversazione*; one each to the Medical Society of Boston and to the Imperial Medico-Chirurgical Academy of St. Petersburg "of which I am an unworthy Member". Sir William Blizard had already

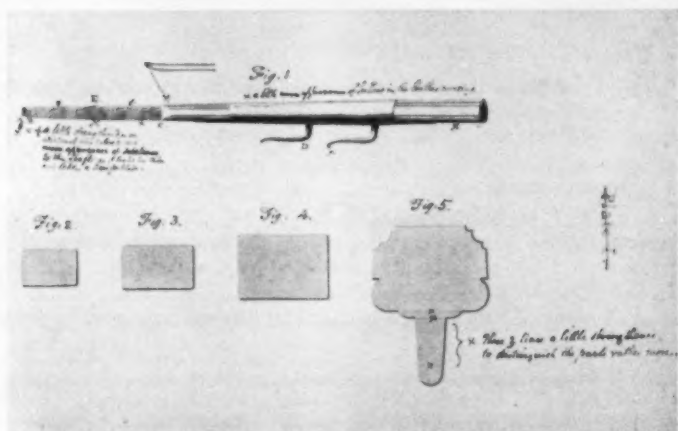


Fig. 3. Reduced copy of a proof plate with Clift's comments showing the thickness of the shaft at four points. At the first tug-iron, the limit of penetration through the thorax, it measured six inches in girth.

sent copies to Cline, Abernethy, Norris, the Parkinsons, and had received acknowledgments from the Duke of Gloucester and Sir Astley Cooper.

In July 1824 Maiden requested Clift to pay Basire £30 and Cox £20; a year later a further bill arrived from Cox and Barnett for £48 2s. Maiden writes: "I do not know what is the usage of the poor authors on these occasions, but as money is generally acceptable I send £50 for which please to take a receipt".

It is fortunate that we have Clift's illustrations of Mr. Tipple's thorax and of the gig-shaft as the original specimens, which were notable exhibits in the Museum for more than a century, were destroyed by enemy action in 1941. The description of the specimens in the *Catalogue of General Pathology*, 1, 1846, p.19, is as follows:

"Part of the anterior wall of a man's chest, through which the gig-shaft, which is placed near the preparation, was driven long before death. The shaft entered on the left side between three and four inches from the sternum, just beyond the margin of the pectoralis major, and between the second and third ribs; it was driven across the mediastinum, and passed out of the thorax about three inches from the right side of the sternum, between the second and third ribs, fracturing the third rib. In its passage it also appears to have separated the two upper portions of the sternum and to have driven their adjacent margins forwards. The tug-iron of the shaft penetrated the chest and the lung rather lower down on the left side between the third and fourth ribs. The patient lived more than ten years after receiving the injury, and the preparation shows; on its anterior aspect, the thin tough layers of cicatrix-tissue by which the apertures in the walls of the chest were closed, the firm union of the fractured and displaced portions of the second left rib, the repair of the other ribs and of their cartilages, and the tough ligamentous portions of the sternum on its posterior aspect, the preparation exhibits portions of the lungs adhering to the inner surface of the new tissue by which the apertures in the walls of the chest are closed, and a posterior view of the union between the portions of the sternum and the second left rib.

The tug-iron must have wounded the lung (for air and blood escaped from the wound it made) but the shaft itself may have passed in front of, at least, the right pleura."

No case parallel to the above has been found in the medical literature, the only other case where a "shaft" was implicated being that of Popovici, 1937, but here the damage was not transverse though more serious. The chief interest in Maiden's case is that the patient escaped severe injury in what was at first sight a fatal accident. This was due to the shape of the shaft which, being bevelled at the end, thrust aside the vital organs in its passage through the chest. Injuries much more severe have been caused by steel rods, wooden stakes and sword thrusts, and references to these cases and abstracts where possible are appended. It is gratifying to note that of 18 reported cases only one was fatal, the remaining seven are not available for abstracting.

"A Man's Chest Transfixed" (1832). Complete recovery, and present condition. *Lancet* (1859) 1, 45.

John Taylor, a sailor aged 20, was guiding a mast when the supporting tackle broke and the iron pivot attached to the mast tore off half his scalp, fractured his jaw and threw him to the deck. The pivot ran obliquely through the chest, came out in the lower part of his back and pinned him to the deck. He was treated in the London Hospital and recovered in five months and when examined 27 years later was in good health.

A drawing by William Clift of the man's wound and the bolt were in the Museum of the Royal College of Surgeons until the blitz of May 1941.

DUPUYTREN (1834) "Blessure pénétrante de la poitrine". *Rev. med. franç. étrang. Par.* (1834) 1, 387. *Abstr. Boston med. surg. J.* (1857) 55, 387.

The patient, a child, fell from a cherry tree on to the end of a wooden stake which pierced the chest from behind forwards, through the thorax and abdomen and emerged at the right groin. The oaken stake, two fingers' breadth in thickness, was broken off but enough projected by which to extract it. The child made a good recovery in fifteen days.

SEWELL, E. Q. (1849) *British Amer. J. med. phys. Sci.* Montreal, (Feb. 1849). *Abstr. Amer. J. med. Sci.* (1849). N.S. 17, 504.

A lad fell on the blade of a scythe which entered the right axilla between the third and fourth ribs and emerged through the corresponding ribs of the opposite side. The lad lay still while his brother, who was on the spot, slowly withdrew the blade, observing cautiously its curvature as he did so. Haemorrhage was not excessive and the patient walked home with his brother's assistance. It is said that no spitting of blood occurred and the lad made a good recovery.

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SARGENT, J. (1851) "Impalement of abdomen and thorax, with dissection twenty years subsequently". *Boston med. surg. J.* (1872) N.S. 9, 117.

A woman, aged 37, fell from a loft on to a pitchfork handle which entered the body at the vagina to a depth of twenty-two inches till arrested by the upper left rib and by the woman's feet reaching the floor. She recovered from the accident, but suffered much during the next twenty years. At the postmortem, an extraordinary condition was disclosed. The left chest was filled with the contents of the abdomen—the stomach, transverse colon, part of the descending colon and a considerable portion of the small intestines had passed through an opening in the diaphragm at the left of the median line.

LISSAIGNE (1854) "Cas de perforation transversale de la poitrine par un échelas—guérison". *J. Méd. Bordeaux.* (1854) 12, 513–20.

While picking cherries a young soldier fell from the tree on to a strong stake which pierced his chest from side to side and held him transfixed for an hour and a half. He was freed by cutting away the stake and then conveyed to hospital as quickly as possible. On arrival he was in good condition and with a moderate degree of traction the stake was withdrawn from the wound. During the next few days, five bleedings were necessary but thereafter he improved and was convalescent three weeks after the accident.

HUMPHREYS (1871) "Remarkable case of impalement". *Med. Times, Lond.* (1871) 2, 392.

A boy, aged 11, fell on a sharp-pointed stake of which 17½ ins. pierced the body from its entry at the scrotum, through the abdomen and thorax, traversing the left lung, and passing out along the upper third of the humerus which it kept extended above the boy's head. The patient was held down by four strong men while the surgeon and his colleague used all their strength to remove the stake. The patient was ill for six weeks, after which he was able to sit up and play. In five months he had recovered though the right testicle was absent and the heart beat at the apex was still an inch out of place.

LONGMORE, T. (1871) "Transfixion of the right side of the chest and right lung by a lance, with recovery". *Lancet* (1871) 1, 78.

As a trooper was mounting a horse the animal reared and the lance he was carrying was thrust forcibly into the man's chest and the point of it came out through his scapula. In a panic the man fell from his horse and the butt of the lance struck the ground with such force that the shaft broke and the protruding portion was increased to over 8 ins. in length. After many attempts, which included the services of the armourer-sergeant, the lance was removed from the man's chest and he was discharged from hospital at the end of two months.

BROWN, G. W. (1877) "A case of thoracic impalement". *Tr. med. Soc. Penn. Phila.* (1877) 11, Part 2, 730.

HULKE (1888) "Transfixion of the chest by a shred of glass; recovery". *Lancet* (1888) 1, 68.

A woman, aged 62, fell from a pair of steps while holding a large glazed picture. The glass was shattered and a piece was seen to be sticking in her back. This was removed, but not preserved by her fellow servant who described it as large and long. On examination it was found that the tenth rib had been cut through and in front of the chest was another wound about ¾ of an inch long. No operation was performed and the patient was out of bed 24 days after the accident; her recovery was delayed by a slight pleurisy of the wounded side and bronchitis.

BÉRARD (1900) "Plaie perforante de poitrine de part en part par canne à l'épée; suites remarquablement bénignes". *Bull. Soc. Chir., Lyon* (1900–01) 4, 142–4.

POPOVICI, A. N., and POPESCU, C. (1937) "Seltener Fall einer Brustkastenverletzung". *Zbl. Chir.* (1937) 64, 2527–29.

A car and a horse-drawn wagon collided head on and the lungeing of the horse forced a shaft through the front of the car and impaled its driver. The shaft was sawn through and the patient removed to hospital in bad condition. Here the shaft was



withdrawn and was found to measure 25 ins. long and 3 ins. thick with a large hook at the end. A great wound was disclosed running through the left of the thorax from the nipple in front to the posterior axillary line. The opening was so large that one person looking through could see another on the opposite side. The ribs 4-7 were fractured and their fragments, together with strips of skin, were visible in the wound. Injuries to the diaphragm, lung and heart were repaired and in two months the patient was out of bed and in six months was convalescent.

DE STERNI, S. (1938) "Injury caused by a spontoon (halberd) passing through the thorax". *Arch. ital. Chir.* (1938) **51**, 650-56.

HAMBLY, E. H. (1938) "Injury by a steel rod piercing perineum, abdomen, and thorax". *Lancet* (1938) **2**, 672.

A boy, aged 15, fell on a steel rod which pierced the body for 18½ ins. from the perineum to the left sixth interspace in the chest. At operation, injuries were found in the pelvic mesocolon, the transverse colon and small intestine, the great omentum and the left rectus abdominis muscle. These were repaired and the abdominal wall and thoracic wound were closed without drainage. The patient made an uninterrupted recovery.

CURPHEY, T. J., and FREIDRICH, A. W. (1939) "Unusual fatal perforating wound of the chest". *Amer. J. Dis. Child.* (1939) **58**, 1278.

A boy, aged 4½ years, fell off his tricycle into a patch of newly cut elderberry bushes, one of the sticks piercing his chest. He died in 15 minutes and the post-mortem showed that the stick had pierced the intercostal muscles and parietal pleura and passed through the apex of the left lung, terminating in a laceration of the capsule of the thymus gland. The copious haemorrhage probably came from the left superior intercostal vein or the thymic tributaries of the left innominate vein.

TOMILIN, A. I. (1940) "A case of penetrating wound of the thorax (impalement on wooden pitchfork) with recovery after suture". *Vestnik khir.* (1940) **59**, 643-44.

CAMARA, A., and KELNER, S. (1945) "Case of accidental impalement (thoracoabdominal)". *Rev. méd. panamer.* (1945) **2**, 174-77.

BESSEMANS, A. (1948) "A propos de la prétendue invulnérabilité de 'Mirin Dajo'". *Brux. méd.* (1948) **28**, 519; 584.

At public performances Dajo allows himself to be transfixed by swords which have not been sterilised. The vital organs in the chest including the heart are said to have been pierced without haemorrhage or ill effects. The man is supposed to be under hypnosis while the transfixions are performed.

SCHMITT, W. (1949) "Severe thoracic impalement injury by iron pipe with involvement of mediastinum and opening of both pleural cavities; recovery without complications". *Zbl. Chir.* (1949) **74**, 225-30.

DELOM, P., and RIGOLLET (1950) "Transfixion of left thorax by bamboo pole". *Extrême-Orient méd.* (1950) **3**, 162-63.

ALESSI, A. (1952) "Unusual case of complete bilateral transverse impalement; successful surgical treatment". *Policlinico (sez. prat.)* (1952) **59**, 1490-96.

A man, aged 45, fell from a roof on to the handle of a fork which pierced the thorax. The pole entered the body at the right axilla and was thrust transversely through the chest and emerged from the left axilla where it projected about two inches. The pole had broken mid-way under the weight of the man's body leaving about a foot projecting at the point of entry. At operation, it was found that the patient had suffered a bilateral wound of the pleura and perforation of the mediastinum but in twenty-seven days he was able to leave hospital in good health.



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BATTEN, R. (1953) "A traumatic haemothorax". *Lancet* (1953) 2, 811.

A boy of eleven years fell from a tree and a broken stick of cherry wood  $8\frac{1}{2}$  ins. long by 1 inch in diameter passed through the abdomen into the left side of the thorax without damaging any abdominal viscus, the heart or ribs. The patient recovered after the stick was extracted.

HUFNAGL, A. (1953) "Severe trans-thoracic impalement injury of miner caused by boring rod". *Zbl. Chir.* (1953) 78, 1370-71.

KOLB, A., and ZÄNGL, A. (1955) "Experiences with impalement injuries and report of successful surgery of a patient with thoraco-abdominal pericardiac impalement with piercing of liver and haematopericardium". *Arch. orthop. MechTher.* (1955) 47, 145-48.

KRÖNKE, E. (1955) "Perforierende Pfählungsverletzung des Thorax mit Durchbohring des Herzens". *Chirurg* (1955) 26, 181-84.

A girl, aged 13, fell from a rick on to the metal spike of a hay wagon standing below. The spike entered her body at the lowest rib on the right side and emerged at the left breast. The spike was apparently displaced downwards so that the girl's body was freed and fell to the ground where she lay unconscious for ten minutes.

At operation, the liver, kidney and lung were found to have escaped damage, but the lung was compressed by a large haemorrhage which had issued from the opening in the pericardium. It was necessary to suture three wounds of the heart which included injury of the walls of the right ventricle and inferior vena cava. During the repair of these wounds the pulse became very irregular and stopped, but began again when the heart was restored to its place.

The operation was completed, an opening left for drainage, and the patient was returned to the ward in good condition. Antibiotics were employed, but during the next three days the patient relapsed. On the fourth day there was a general improvement and the girl was able to leave her bed five weeks after the accident.

#### NOTES

Mr. Tipple seems to have been a "tough" character. When the shaft had been withdrawn from his body he noticed that he was not bleeding as he would have wished; moreover, he had no feeling of faintness until he had climbed unaided to a bedroom on the second floor. He was repeatedly asked if he suffered pain in the back, apparently to discover whether some of the great nerves had been involved in the accident, but apart from smarting of the wounds and pain of the fractured sternum he denied having any trouble that could be referred to a definite neurological source.

Dr. J. W. J. Parkinson, the patient's medical attendant during the last years of his life, later became the editor of *Hunterian Reminiscences*.

William Clift, first Curator of the Museum of the Royal College of Surgeons, was much involved in this case. He was present when the patient was examined at the London Hospital after his recovery. He was probably the chief operator at the postmortem and thereafter was responsible for seeing the *Account* through the press and for its drawings. Professor Wood Jones said this of him: "But Clift was far more than the mere *fidus Achates* of the great John Hunter. Coming to London at the age of seventeen, an only partly educated lad of humble origin, he was

elected to the Fellowship of the Royal Society before he was forty-nine, having already taken his place as one of the outstanding figures in the scientific life of the metropolis. Nevertheless, it is his admiration of Hunter and his loyalty to his memory that constitute one of the most attractive aspects of Clift's character. It was as an outcome of this loyalty that the Hunterian Museum was preserved and kept in good order after John Hunter's death and so remained to be placed in the custody of the Royal College of Surgeons on behalf of the nation."

This extract is from the foreword to *William Clift* by Miss Jessie Dobson, Curator of the Hunterian Museum, published by Heinemann, London. Such a book was long overdue, but Miss Dobson has made amends by her story of a remarkable man; she has produced a fascinating book which clings to the hand when one should be abed.

An additional letter by Maiden was presented to the College Library in March 1958 from the Sherborn Collection. It concerns a Mr. Gibson who was connected with "The Laboratory", Stratford. He is anxious that the Clifts, Mr. Warburton, and Mr. Webster should visit him for dinner at five o'clock prior to which he would arrange for them to go to Ilford, apparently to see the remainder of the elephant bones, still partly embedded deep in the ground. Some had already been received by Mr. Gibson at the Laboratory.

The travellers were advised to journey from Town by the stage-coach "Bow" starting at the "Black Boy and Camel", Leadenhall Street, or by the "Stratford" from Aldgate Pump.

The Mr. Webster referred to was Thomas Webster, 1773-1844, house-secretary to the Geological Society and Curator of their Museum.

Henry Warburton, 1784(?) - 1858, was Chairman of the Parliamentary Committee on the study of Anatomy. His work led to the Anatomy Act of 1832.

It would be difficult to find humour in Mr. Tipple's tragic accident, but the reporter of the *National Register* made a wry attempt when he wrote:

"The horse when he made of his rider a cripple  
Was thirsty perhaps and went forward to Tipple."

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#### ANATOMICAL MUSEUM

THE SPECIAL DISPLAY for the month of February consists of photographs of instruments and residencies of John Hunter, together with a replica of his thermometer.

## REBUILDING OF THE COLLEGE PROGRESS REPORT: PHASE IIIB

IN THE SEPTEMBER 1960 number of the *Annals*, there appeared a report on the work now in progress, illustrated by photographs, and covering what has always been known as Phase IIIB, which is assumed to be the "final phase" of the great rebuilding scheme.

The present report will bring the picture up-to-date, but before describing this there are one or two points which should be referred to, first, that the constructional work has had to be sectionized into (a) reorganizing and modernizing the fourth, fifth and sixth floors of the old College to enlarge the various Departments; and (b) the second section, the

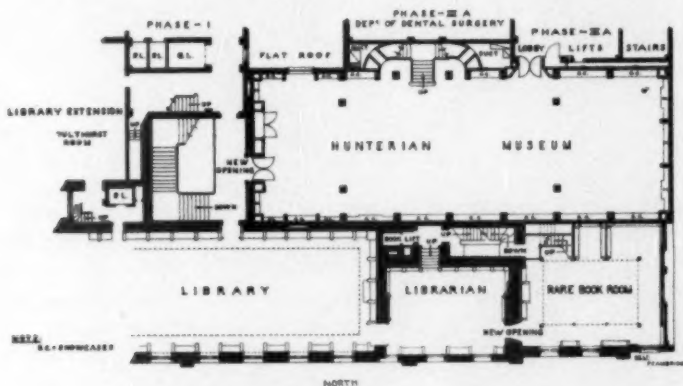


Fig. 1.

building of the ground floor Lecture Rooms, with, on the first floor, the Hunterian Museum and its gallery at second floor level, and finally at the Western end of the Royal College site a section of new building will be built to house on the third floor the offices for the Joint Secretariat, and on the fourth, fifth and sixth floors new Laboratories for the adjacent Departments, thus linking together the Departments in Phase IIIa and those in the old College buildings.

There are many difficulties arising in the reorganization of the three floors in the old College, as it was only possible to deal with one floor at a time, starting on the fourth floor, and some small portion of the sixth floor. This work is proceeding satisfactorily but has entailed much disturbance to those working in the two upper floors, but the Professors have been very forbearing and helpful.

#### REBUILDING OF THE COLLEGE

Meanwhile, all the constructional work has been proceeding, forming the ground floor Lecture Room and the Hunterian Museum. This part of the work is well advanced and is really at this stage stock pattern building in reinforced concrete. It is made difficult owing to the position of the work in the heart of the site, the area of operation being surrounded on all sides either by existing buildings, or on the West side by the new Imperial Cancer Research Fund building, which is going up at the same time through the same Contractors.

It will not be long now before it will be possible to walk (at some personal risk!) into the formed Hunterian Museum, and when it has its curved roof on it will be possible to get some idea of the size, shape, and arrangements for what, it is hoped, will be the best Museum of its kind in London.

To enable those interested to understand what is being done, the plan of the Hunterian Museum at first floor level is given, showing the general layout of this great room (Fig. 1).

In addition to the work now proceeding, there has been a complete reconstruction of the Inner Hall, illustrated by the photographs, and this work is complete. It has involved great structural problems, in that four of the main columns had to be removed as they were found to be not strong enough to take the weights of the new work. It was necessary, therefore, to replace the old columns with new steel stanchions and this was done without in any way disturbing the main College buildings.

The effect of this reconstruction has been to give a fire-resisting floor over the Inner Hall and added height plus a new coffered ceiling. The general effect has been to open up the through vista and give an appearance of greater space.

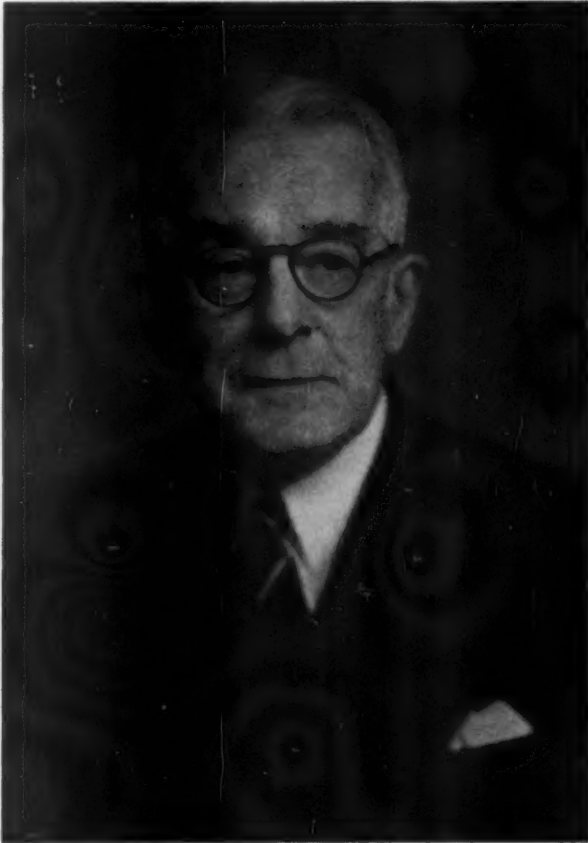
Much remains to be done before all the work in Phase IIIb is completed, but, with the constructional work design settled, the Contractors are now able to go ahead. There remains, of course, the introduction of all the specialists' work to be installed, such as heating, ventilating, and all the electrical work. Here again some work has already been done, and in the basement plant rooms are being prepared, and the plant will be placed in position together with the ducting work for ventilating, etc., as the inner walls are built.

A. W. H.

*In Memoriam*

**SIR ERNEST FINCH, M.D., M.S. (Lond.), F.R.C.S., Hon. D.Sc.  
(Sheffield), Hon. F.R.C.S.I.**

ERNEST FINCH DIED on 16th December at the age of 76 after a long illness, which he suffered with characteristic courage and patience. His death is a sad loss to surgery, to the College and to a great multitude of friends.



Sir Ernest Finch (1884-1960)

#### IN MEMORIAM

He was born in Sheffield and entered the University College of Sheffield in 1901, qualifying M.B., B.S. (Lond.), in 1906, for at that time the Sheffield College has not attained University status, and the few medical students graduated in London. In 1905, the College was granted its Charter as a University, and in 1908 Ernest Finch was admitted to the M.B., B.Ch., degree *ad eundem*. He took the M.D. (Lond.) in 1909, the F.R.C.S. in 1911 and the M.S. (Lond.) in 1913.

After qualifying he worked as a demonstrator in the Department of Physiology in the new University, where he acquired an abiding interest in the teaching of the basic medical sciences. He entered the Sheffield Royal Infirmary as a House Surgeon to Sinclair White in 1907 and worked in that hospital continuously until his retirement from the active staff in 1944. He was elected Assistant Surgeon in 1912 and full surgeon in 1919. During the first World War he served as a Major in the R.A.M.C., first in France with the 3rd West Riding Field Ambulance (T.A.) and later with the 3rd Northern General Hospital in Sheffield. Ernest Finch devoted his life to surgery, to the Sheffield Medical School and to the Royal College of Surgeons.

After the first War he rapidly became the leading surgeon in the Sheffield area. He had an extraordinary ability to inspire confidence in patients and their relatives by his gentleness and consideration. Hearing him talk to seriously ill patients and their relatives taught generations of house surgeons that there is more in surgery than scientific diagnosis and expert operative technique. He was a great friend of young surgeons all over the country, but especially in Sheffield. His advice and help were always promptly available, not only in professional matters, but in all kinds of trouble. He had an amazing memory, never forgetting a pupil, and keeping in close touch by correspondence with many of them. He was always kind, courteous and considerate, and his colleagues and staff were devoted to him. It was characteristic of him that even when he was the senior surgeon he would often, during a busy emergency week, send his tired house surgeon off into the country for the afternoon, whilst he "stood by" in the hospital. Though he could criticize when necessary, his criticism was always gentle and constructive, for he was entirely without envy or malice.

Between the wars Ernest Finch was actively engaged in the teaching of surgery in the Sheffield Medical School, and in 1934 became Professor of Surgery in the University, a post which he held until his retirement in 1944. The rapid development of the Sheffield Medical School and the establishment of the departments of orthopaedics, neurosurgery and chest surgery are largely due to his foresight and enthusiasm. No effort was too much and no personal sacrifice too great, if it was for the advancement of his school and the good of his pupils. On his retirement from the active staff in 1944, his colleagues and former students showed their



#### IN MEMORIAM

appreciation of his work for the school by founding the Ernest Finch Medical Library in the Royal Infirmary, and in 1960 the Sheffield Medical Graduates Association asked permission to commission his portrait, which they wished to present to him as a token of their affection and regard. Unfortunately his last illness made this impossible, but he was greatly touched by their request.

He was elected to the Council of the Royal College of Surgeons in 1940, and served until 1956, being Vice-President of the College in 1953 and 1954, and successively Bradshaw Lecturer, Vicary Lecturer and Hunterian Orator. His quiet and unassuming work for the College was recognized by the high regard and affection in which he was held by his colleagues on the Council, and by the confidence and trust which surgeons throughout the country had in him. His long service on the Council culminated in his memorable scholarly Hunterian oration and his entertaining and accurate history of the College Council Club. He was sure that the College was the centre of surgical teaching in the Commonwealth, and a model for the world, and, as such, its tradition, present activities and future were indeed close to his heart.

His abilities were recognized by many honours—he was created a Knight in 1951, he was Vice-President of the College in 1953 and 1954, and he also received Honorary D.Sc. of Sheffield and the Honorary Fellowship of the Royal College of Surgeons of Ireland. He was President of the Association of Surgeons and of the surgical section of the Royal Society of Medicine. All these pleased him greatly, but he characteristically regarded them as honours to his school rather than to himself.

In private life he was a superb host and a wonderful conversationalist. He had a great affection for the Yorkshireman and his fund of Yorkshire stories told in the true dialect were a delight to his friends.

He will be remembered not only as a great surgeon, but as a kind, generous and lovable man, a staunch friend and a true humanitarian, surely the greatest tributes of all.

He leaves a widow and a son, to whom we extend our sympathy.

F. W. H.

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#### LOUIS BAZY, Honorary F.R.C.S. (1883–1960)

LOUIS BAZY PLAYED a notable part in maintaining the entente between the surgeons of France and Great Britain, and he cherished his Honorary Fellowship of the College as one of his greatest achievements. For many years he was one of the outstanding leaders in French surgery and, during his long and distinguished career, his contributions to surgical literature ranged over a wide field. He was also active in public affairs. In the College, many will recall his dignified bearing and the charming speech he made at the Dinner during the Reunion with l'Académie de Chirurgie de Paris held in London in 1957.

H. P.

## PROCEEDINGS OF THE COUNCIL IN JANUARY

AT A MEETING of the Council on 12th January 1961, with Sir Arthur Porritt, President, in the Chair, Colonel J. C. Watts was admitted as the Joint Professor of Military Surgery in the Royal Army Medical College and the Royal College of Surgeons.

Mr. G. T. Hankey was presented with the John Tomes Prize for the period 1957-59 for clinical research.

A resolution of condolence was passed on the death of Sir Ernest Finch (past Vice-President).

Mr. W. Gissane was appointed as Robert Jones Lecturer for 1961.

Dr. G. S. W. Organe was appointed as Joseph Clover Lecturer for 1962.

Dr. Frank Stansfield was re-appointed Bland-Sutton Lecturer for the period 1960-1963.

It was agreed that the next Annual Meeting of Fellows and Members be held in Sheffield on Friday and Saturday, 24th and 25th November 1961.

Dr. Margaret A. Branthwaite and Dr. A. Garendran were awarded the Nuffield Prizes for anaesthetics.

A Diploma of Membership was granted to E. S. Marsden.

A Diploma of Fellowship was granted to G. V. Shead.

The following Diplomas were granted, jointly with the Royal College of Physicians: *Laryngology and Otology* (24), *Anaesthetics* (84), *Medical Radio-Diagnosis* (29), *Medical Radiotherapy* (12), *Psychological Medicine* (46), *Pathology* (8), *Public Health* (24), *Tropical Medicine and Hygiene* (7), *Industrial Health* (1), *Child Health* (1).

The following hospitals were recognized under paragraph 23 of the Fellowship regulations:

HOSPITALS	POSTS RECOGNIZED		
	General (6 months unless otherwise stated)	Casualty (all 6 months)	Unspecified (all 6 months)
BRIGHTON—The Royal Sussex County Hospital (additional)	Regr. (to the Group) (12 months)	S.H.O.	Under para. 23 (c) S.H.O. (E.N.T.)
WHITEHAVEN Hospital (additional)	H.S.	H.S. (Cas. & Orth.) also to be recog- nized under "un- specified" column	
SALFORD—Royal and Hope Hospitals (additional)			
LONDON—Whittington Hospital (extension of period of recogni- tion)	3 Regrs. for 12 months instead of 6 months		
BURNLEY—Victoria Hospital (additional)		2nd S.H.O. (Cas. & Orth.) (Casualty or Unspecified) J.H.M.O.	

After the meeting a Hunterian Lecture was delivered by Professor F. G. Ellis on "The aetiology and treatment of achalasia of the cardia".

### RETIREMENT OF SIR WILFRED FISH, C.B.E.

THE RETIREMENT OF Sir Wilfred Fish as Honorary Director of the Department of Dental Science brought to an end an interesting and, in many ways, remarkable chapter in the story of research activities within the College.

It was towards the end of 1955 that an appeal was first launched for funds to equip and maintain a dental research unit to be housed in the building extensions being planned at that time. Sir Wilfred, as Honorary



Sir Wilfred Fish, C.B.E., M.D., D.Sc., F.D.S.R.C.S.

Director, was deeply involved from the outset, not only in designing and equipping the new laboratories, not only in the drive to raise funds from commerce and industry, but, perhaps most important of all, in formulating a programme of research to be carried out in the years to come. Into all these activities he threw himself with the skill and the enthusiasm that have characterized his many years of service to the dental profession.

The fruit of his efforts is to be seen in the fact that in the five years between Sir Wilfred's assumption of duties and his retirement, a fully

SIR WILFRED FISH, C.B.E.

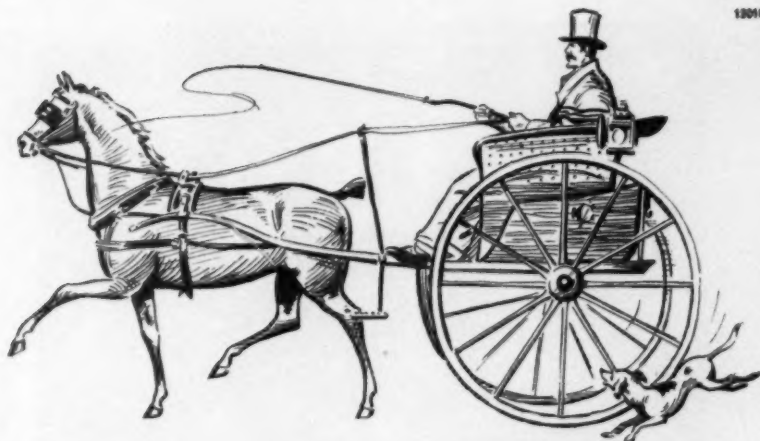
equipped, fully staffed, and functioning dental research unit has come to thrive within the College. To those who are acquainted with Sir Wilfred's original contributions to dental research in the years between the wars, his guiding influence will readily be detected in the early reports published of work carried out in the Department. There can be no better promise of things to come than the hope that his inspiration will remain apparent in the Department he did so much to create.

### DIARY FOR FEBRUARY

Wed.	15	D.M.R.D. Examination (Part I), D.M.R.T. Examination (Part I) and D.T.M. & H. Examination begin.
Thurs.	16	D. Phys. Med. Examination (Part II) begins.
Fri.	17 5.00	DR. HAMILTON B. G. ROBINSON—Webb-Johnson Lecture—The effect of operative procedures on the pulp.
Mon.	20 5.00	Professor ARNOLD SORSBY—Ophthalmology Lecture—Experimental degeneration of the retina and its clinical implications.
Tues.	21 5.00	Professor ARNOLD SORSBY—Ophthalmology Lecture—The nature of refractive errors: the present position.
Wed.	22	Primary F.D.S. Examination and D.M.R.D. Examination (Part II) begin.
Thurs.	23 5.00	Professor C. E. DREW—Hunterian Lecture—Profound hypothermia in cardiac surgery.
Tues.	28 4.15	DR. R. MCP. LIVINGSTON—Arnott Demonstration—Conjoint twins.

### DIARY FOR MARCH

Wed.	1	D. Orth. Examination and D.M.R.T. Examination (Part II) begin.
Thurs.	2 5.30	Professor L. P. GARROD—Otolaryngology Lecture—Principles of antibiotic therapy in surgery.
Sat.	4	Annual Examinerships and Lectureships advertised.
Tues.	7 5.00	DR. L. W. PROGER—Erasmus Wilson Demonstration—Pathology in Hunter's museum.
Wed.	8	First L.D.S. Examination and D.C.H. Examination begin. Election to the Board of Faculty of Anaesthetists.
Thurs.	9 2.00 5.00	First Membership Examination begins. Ordinary Council. Professor R. C. CONNOLLY—Hunterian Lecture—Cerebral ischaemia in spontaneous subarachnoid haemorrhage.
Wed.	15 3.00 4.00	Faculty of Anaesthetists—Annual General Meeting. DR. R. P. W. SHACKLETON—Frederic Hewitt Lecture—In the end is my beginning.
Thurs.	16	Pre-Medical Examination begins.
Fri.	17 5.00	Board of Faculty of Dental Surgery.
Thurs.	23 5.00	Professor W. BRYAN JENNETT—Hunterian Lecture—Epilepsy after blunt head injury.
Mon.	27 5.00	Final Membership Examination begins. DR. WALTER S. STILES—Edridge-Green Lecture—The directional sensitivity of the retina.
Fri.	31	Good Friday—College closed.



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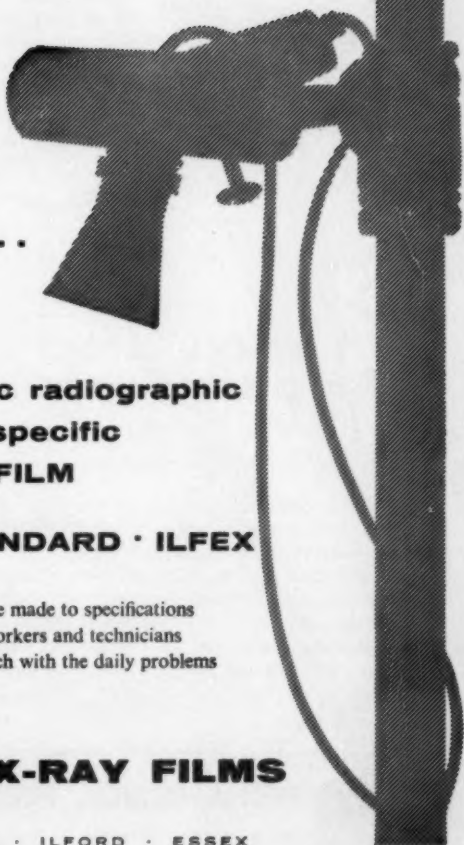
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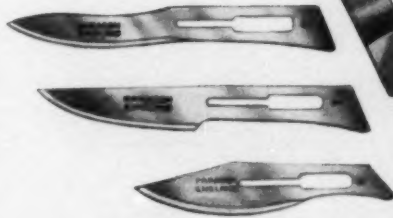
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